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AIR FORCE INSTRUCTION 10-602

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Operations

DETERMINING LOGISTICS SUPPORT AND READINESS REQUIREMENTS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction implements AFPD 10-6, *Mission Needs and Operational Requirements*, and DoD Instruction 5000.2, *Defense Acquisition Management Policies and Procedure*s, February 23, 1991, with Change 1 and Air Force Supplement 1, *Acquisition Management Policies and Procedures*, August 31, 1993, with Change 1. It provides a framework for defining readiness and logistics support requirements throughout the system acquisition or modification process.

Use this instruction with AFI 10-601, *Mission Needs and Operational Requirements Guidance and Procedures*, and AFI 99-102, *Operational Test and Evaluation*.

SUMMARY OF CHANGES

This is the first publication of AFI 10-602 revising AFR 57-9.

1. Purpose and Scope. The best opportunity to influence system design is during the early stages of system acquisition. Stating essential qualitative and quantitative readiness and logistics supportability requirements in operational concepts and requirements documents is the most effective way for users to influence the design of their systems.

1.1. This instruction provides a method for defining and continually refining weapon system's readiness, sustainability, deployability, and logistics and support requirements. It describes how to develop reliability and maintainability parameter requirements for each type of weapon system.

All terms and measures mentioned in this instruction describe operational characteristics.

1.2. Attachment 1 provides a list of common terms as used in this instruction, as well as related sources of information. Attachment 2 is an overview of the ILS elements providing areas to consider when developing logistics requirements. Attachments 3 through 10 discuss readiness, combat capability, and supportability measures for different types of weapon systems. When developing requirements for command, control, communication, and computer (C4) systems see AFI 33-103, *C4 Systems Requirements Development and Processing*.

2. Logistics Requirements Process. Major commands (MAJCOM):

- Establish logistics and mission requirements simultaneously for acquiring and modifying new systems.
- Define logistics requirements using Strategy to Taskstrategy to task (STT) Analyses through the Air Force Operational Requirements and Modernization Planning Process. STT analyses link logistics requirements, through operational tasks, to national security objectives.

2.1. Identifying Logistics Requirements. When defining or reviewing system requirements, MAJCOMs consider system characteristics and parameters that affect operating and support costs.

See attachment 2, figure A2.1 for a list of parameters to keep in mind. Since logistics requirements vary in detail depending on the phase of the system's life cycle, MAJCOMs must identify these requirements as early as possible during the acquisition process and refine them as the system and the operational concept develop. When possible, MAJCOMs must apply technology forecasts to system requirements and Air Force plans and goals.

2.2. Developing Logistics Requirements:

2.2.1. MAJCOMs must develop and continually refine logistics requirements using the Systems Engineering and Configuration Management (SE/CM) process as described in MILSTD 499B, *Systems Engineering*. To develop logistics requirements MAJCOMs:

- Investigate support concepts for similar systems and quantitatively compare existing readiness and sustainability measures.
- Confer with single managers (SM) to develop logistics requirements.
- Use the Air Force Lessons Learned database to avoid repeating design and support problems.
- Cite critical logistics characteristics and express logistics requirements in specific terms.
- State firm requirements versus negotiable goals.
- Eliminate contradictions and redundancies in various operational requirements.
- Consider surge and combat support needs at austere sites when planning logistics capabilities.
- Rank all requirements for assessing tradeoffs during the development process.
- Define broad support characteristics using attachment 2.
- Tailor support characteristics during the requirements development process.
- Consider the measures in attachments 3 through 10 when describing top-level operational and support requirements.
- Select, tailor, and justify appropriate operational and support measures based on mission area assessments, comparability studies, or projected maintenance capability studies.

2.3. Other Considerations for Determining Logistics Requirements:

2.3.1. Emphasizing Operational Needs. MAJCOMs:

- Convey the importance of supportability requirements in the system's overall mission capability.
- Identify and document supportability constraints in the mission needs statement (MNS).
- Establish logistics and supportability thresholds and objectives in the operational requirements document (ORD).
- Document the methodologies used to develop specific requirements and keep an information trail that traces evolution of these requirements.

2.3.1.1. SMs will include key supportability performance parameters in the acquisition program baseline (APB).

2.3.2. Using Analytical Models. MAJCOMs:

- Use analytical and modeling techniques to select and refine final system operations and logistics support and readiness requirements for complex, highly integrated weapon systems.
- Use an applicable weapon system model to establish, refine, and document the interrelationships and priorities among the various operational and logistics requirements. This model must use available parametric or quantifiable data.

NOTE:

Often, the interrelationships between logistics and other performance requirements aren't clear. In many cases, you might not find hard, quantifiable data, only parametric relationships.

2.3.3. Translating Requirements Into Contractual Terms:

2.3.3.1. MAJCOMs formulate logistics requirements as operational characteristics needed in the field.

2.3.3.2. SMs:

- Translate MAJCOM requirements into quantifiable contractual terms and allocate them throughout the design hierarchy.
- Document the methodologies used to translate the requirements into contractual terms and keep an information trail that traces these terms back to the operational requirements.

2.3.4. Stating Requirements in Operational Terms. MAJCOMs state logistics requirements in terms that can be measured during test and evaluation (see attachments 3 through 10). There must be a link between the measures of effectiveness used in cost and operational effectiveness analyses and the measures stated in the test and evaluation master plan.

3. Planning Deliveries. SMs:

- Plan support system deliveries to satisfy operational maintenance requirements.
- Make sufficient quantities of the end item and its associated support system available to satisfy both developmental and operational requirements.
- Ensure that plans take into account the impact of long lead times on system development.

4. Managing Funding. SMs:

4.1. Assess program cost differences associated with different program solutions, some of which may have different readiness, sustainability, and logistics characteristics.

4.2. Program adequate resources to fully fund the research and development (R&D) of logistics requirements to ensure that personnel create a reliable design that incorporates maintenance and support functions. Financial resources include R&D funding for:

- ILS planning.
- Logistic support analysis (LSA).
- Determining life-cycle costs.
- Developing support equipment and technical orders.
- Developing support software.
- Conducting reliability, maintainability, and deployability (RM&D) demonstrations, tests, and modeling.

4.3. Identify funding associated with producing and fielding supported systems. This includes funding for:

- Contractor support.
- Initial and replenishment spares.
- TOs and data.
- Training and training support.
- Facility construction.
- Personnel.
- Common and peculiar support equipment.
- Developmental test and evaluation (DT&E).
- Operational test and evaluation (OT&E).
- Disposal of hazardous materials.

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Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

AFPD 10-6, ***Mission Needs and Operational Requirements,*** **and AFI 10-601,** ***Mission Needs and Operational Requirements Guidance and Procedures*****.** These two documents:

- Establish procedures and assign responsibilities for identifying and processing operational needs and for initiating programs responsive to those needs.
- Summarize the overall DoD system acquisition process and explain its relationship to the Air Force requirements process.

AFI 21-101, ***Maintenance Management of Aircraft.*** This document:

- Establishes the basic system and policy for managing the Air Force equipment maintenance program.
- Includes the requirements for maintenance concepts and plans.

AFI 21-103, ***Aircraft, Missile, and Equipment Accountability.*** This document:

- Prescribes the reporting system for accounting and analyses.
- Provides data on equipment availability and use.

AFI 33-103, ***C4 Systems Requirements Development and Processing.*** Outlines the processing, programming, budgeting, and funding requirements for information systems.

AFI 33-104, ***C4 Systems Base Level Planning and Implementation*****.** Outlines the program management and acquisition processes for information systems.

AFI 36-2201, ***Developing, Managing, and Conducting Military Training Programs.*** Outlines the process for developing military training programs.

AFI 63-117, ***Integrated Manpower, Personnel, and Comprehensive Training and Safety (IMPACTS) Program.*** Prescribes policy and establishes responsibilities for IMPACTS during system requirements definition, engineering development, and program management activities.

AFI 99-101, ***Developmental Test and Evaluation,*** **AFI 99-102,** ***Operational Test and Evaluation,*** **and AFI 99-109,** ***Test Resource Planning.*** Prescribes policy and assigns responsibilities for testing and evaluating Air Force systems during development, production, and deployment.

DoD 5000 Series Documents. Directs and describes the system acquisition process.

AFP 800-7, ***The USAF R&M 2000 Process.*** This document:

- Describes reliability and maintenance (R&M) practices for increasing combat capability while saving resources.
- Outlines Air Force goals for identifying operational R&M requirements using a building block approach.

MILSTD 499B, ***Systems Engineering.*** Describes the process for evaluating system requirements with event-based decisionmaking methods that cover the system's entire life cycle.

Abbreviations and Acronyms

Ao—Operational Availability

AETC—Air Education and Training Command

AFRES—Air Force Reserves

ANGRC—Air National Guard Readiness Center

APB—Acquisition Program Baseline

ARC—Air Reserve Component

BIT—Built-In Test

BITFD—Built-In-Test Fault Detection

CA—Control Availability

CALS—Computer-aided Acquisition and Logistics Support

CD—Control Dependability

CE—Control Effectiveness

CFI—Critical Faults Identified

CM—Corrective Maintenance

CMTBCF—Control Mean Time Between Critical Failure

CMTBDE—Control Mean Time Between Downing Event

CMTTRF—Control Mean Time To Restore Function

CMTTRS—Control Mean Time To Restore System

CND—Cannot Duplicate

COMR—Communication Reliability

CR—Control Reliability

Do—Operational Dependability

DOC—Designated Operational Capability

DoD—Department of Defense

DT&E—Developmental Test and Evaluation

ESRT—Essential System Repair Time

FA—False Alarm

FD—Fault Detection

FI—Fault Isolation

FMC—Fully Mission Capable

ICBM—Intercontinental Ballistic Missile

ID—Integrated Diagnostics

IFR—Inflight Reliability

ILS—Integrated Logistics Support

IMPACTS—Integrated Manpower, Personnel, and Comprehensive Training and Safety

IRSP—In-Place Readiness Spares

ISO—International Standards OrganizationInternational Standards Organization

LA—Launch Availability

LD—Launch Dependability

LE—Launch Effectiveness

LMTBCF—Launch Mean Time Between Critical Failure

LMTBDE—Launch Mean Time Between Downing Event

LMTTRF—Launch Mean Time To Restore Function

LMTTRS—Launch Mean Time To Restore System

LR—Launch Reliability

LRM—Line Replaceable Module

LRU—Line Replaceable Unit

LSA—Logistics Support Analysis

MAJCOM—Major Command

MAP—Mission Area Plan

MC—Mission Capable

MDT—Mean Downtime

ME—Mission Effectiveness

MESL—Mission-Essential Subsystem List

MLV—Memory Loader Verifier

MMH/FH—Maintenance Man-Hours per Flying Hour

MMH/LU—Maintenance Man-Hours per Life Unit

MMH/PH—Maintenance Man-Hours per Possessed Hours

MMT—Mean Maintenance Time

MMY/L—Maintenance Man-Years per Launch

MNS—Mission Needs Statement

MP/U—Maintenance Personnel per Operational Unit

MR—Mission Reliability

MRSP—Mobility Readiness Spares Package

MRT—Mean Repair Time

MTBCF—Mean Time Between Critical Failure

MTBD—Mean Time Between Demand

MTBDE—Mean Time Between Downing Event

MTBM—Mean Time Between Maintenance

MTBR—Mean Time Between Removal

MTBSM—Mean Time Between Scheduled Maintenance

MTBUM—Mean Time Between Unscheduled Maintenance

MTTR—Mean Time To Repair

MTTRF—Mean Time To Restore Function

MTTRS—Mean Time To Restore System

NMC—Not Mission Capable

ORD—Operational Requirements Document

OT&E—Operational Test and Evaluation

PH—Possessed Hours

PHS&T—Packaging, Handling, Storage, and Transportation

PM—Preventive Maintenance

PMC—Partially Mission Capable

R&D—Research and Development

RM&D—Reliability, Maintainability, and Deployability

RSP—Readiness Spares Package

RSR—Re-Entry System Reliability

RTOK—Retest OK

SA—Space Availability

SAR—Strategic Alert Reliability

SD—Space Dependability

SE—Support Equipment

SM—Single Manager

SMTBCF—Space Mean Time Between Critical Failure

SMTBDE—Space Mean Time Between Downing Event

SMTTRF—Space Mean Time To Restore Function

SMTTRS—Space Mean Time To Restore System

SR—Space Reliability

SRU—Shop Replaceable Unit

T&E—Test and Evaluation

TCTO—Time Compliance Technical Order

TO—Technical Order

UA—User Availability

UD—User Dependability

UE—User Effectiveness

UF/LU—Unconfirmed Faults per Life Unit

UMTBCF—User Mean Time Between Critical Failure

UMTBDE—User Mean Time Between Downing Event

UMTTRF—User Mean Time To Restore Function

UMTTRS—User Mean Time To Restore System

UR—Utilization Rate

UTR—Uptime Ratio

WSR—Weapon System Reliability

WUC—Work Unit Code

Use this glossary as a guide for terms used by the operating, implementing, supporting, and test communities. It is not meant to serve as an authoritative list. Consult other documents, such as MILSTD 721C and AFI 21-103, for reliability and maintainability terms and definitions, and their contextual variations.

Terms

Administrative and Logistics Delay Time—A period of downtime during which no maintenance takes place due to delays in:

- Administrative processing.
- Parts delivery.
- Assignments of maintenance personnel or equipment.
- Transportation.

Alert Reliability—The probability that a weapon or system, once uploaded on a host and accepted for alert, will remain free from critical failure until download or launch.

All-Up-Round—An assembled munitions item that requires only minor hardware accessory attachment before personnel load it on an aircraft or host (for example, a weapon with hardware attachments limited to fins or cables).

Availability—The probability that a system is operable and ready to perform its intended mission at any given time. Availability as a design characteristic may be allocated to system-mission segments or restricted to a particular mission. See "inherent availability" and "operational availability" in this glossary.

Built-In Test—An internal automatic or semiautomatic feature in a system or subsystem designed to detect and identify faults by interrogating a system or monitoring system performance.

Built-In Test Effectiveness—The measure of a system's ability, through automated or semiautomated diagnostic mechanisms, to:

- Detect and identify performance degradation or faults.
- Quickly convey any mission-critical information to the operator in an understandable format.
- Display and/or store all significant fault and associated environmental data for operators or maintenance personnel to use.

Break Rate—The percentage of sorties flown during a specified period of time that return with one or more previously working mission-critical systems or subsystems inoperable, thus rendering the aircraft not mission capable or partially mission capable relative to the previous type mission.

Cannot Duplicate—A situation that results in an operationally observed or recorded malfunction for a system or subsystem that on-equipment maintenance personnel can't duplicate or confirm.

Captive Carry Reliability—The probability that a weapon or system will remain free of critical failure between the time personnel successfully terminate power-on post load check and when they activate command, terminate sortie, or after a specified period of time.

Code 3—An evaluation code used by the operator and maintenance personnel which describes an aircraft returning from a mission with one or more inoperable systems or subsystems that personnel must repair before allowing it to perform "like type" missions. A "code 3" discrepancy on a mission-essential system or subsystem is a failure that makes the aircraft NMC or PMC.

Combat Capability—The number of consecutive events (sorties, miles, orbits, hours) that a weapon system can successfully execute its mission under specified conditions.

Combat Rate—The average number of consecutive sorties an aircraft flies before experiencing a critical failure.

Corrective Maintenance—All actions performed to restore an item to a specified condition after it presents a problem or fails. Corrective maintenance may include:

- Localizing a problem.
- Isolating a problem.
- Disassembling a system.
- Interchanging components.
- Reassembling a system.
- Aligning parts.
- Checking a system out.

Critical Failure—A system degradation, indication of failure, or actual failure that prevents a system from performing a specified mission.

Defect—A product anomaly that causes faults and errors.

Degradation—The gradual decline in a system or subsystem's performance.

Dependability—The probability that an item available at the start of a mission will remain operable and capable of performing its required function at any given time during a specified mission profile. It only applies to systems available at the start of a mission. Dependability may be allocated to system mission segments, for example, space or launch dependability.

Deployability—See System Deployability.

Dormant Storage Reliability—The probability that a system in dormant storage will remain free of critical failure over a specified shelf life. Personnel begin measuring this reliability immediately after completing successful incoming functional or acceptance tests. They take into account the time a system spends in maintenance and other environments, including time for:

- Packaging.
- Handling.
- Storing.
- Transporting.
- Performing surveillance tests.

Downing Event—An event in which the system or subsystem becomes unable to initiate or continue its mission.

Downtime—The time required to restore or maintain a system in mission-capable condition. Includes time spent:

- Responding to a problem.
- Maintaining a system.
- Procuring, handling, or transporting a system.
- Correcting administrative delays.

Environmental Stress Screening—The process of applying one or more specific types of environmental stresses to precipitate failures due to latent, intermittent, or incipient defects or flaws. The purpose is to detect those manufacturing or repair process flaws that would otherwise cause product failure in the use environment. Personnel apply the stresses in combination or in sequence on an accelerated basis within the product's design capabilities. Types of stresses include heat, vibration, and shock.

Failure—In hardware, a condition caused by operational, maintenance, physical or other environments which results in the inability of the equipment to perform its required or expected functions. In software, a system or system part that fails to perform a required function. See "software failure."

False Alarm—A system-indicated malfunction that can't be validated because no request for corrective maintenance follows. A CND differs from a false alarm in that it signifies a malfunction that can't be confirmed.

Fault—A manifestation of a software error in the hardware that causes failure. A fault may be a maladjustment or defect. In software, a fault is caused by defective, missing, or extra instructions or sets of related instructions that result in one or more actual failures or create a problem that could potentially result in failure.

Fault Isolation—The process of systematically tracing any identified system or subsystem or item malfunction to the defective item or component.

Fix Rate—The percentage of incapacitated aircraft per sortie returning with critical failures resulting in a not-mission-capable status that personnel repair and return to a mission-capable status within a specified period of time (for example, 50 percent in 2 hours).

Hazardous Materials—Those materials requiring special handling, storage, and disposal because they are harmful to either the environment, people, or animals.

Hot Integrated Combat Turnaround—An integrated combat turnaround of an aircraft with one or more engines in operation during refueling.

Human Systems Integration—The DoD program designed to integrate human considerations, such as manpower, personnel, training, safety, health hazards, and human engineering, into the design effort. The program addresses total system performance and seeks to reduce the cost of ownership by shifting attention from mechanical issues to the capabilities of the operator, maintenance worker, trainer, and support personnel.

IMPACTS (Integrated Manpower, Personnel and Comprehensive Training—*and Safety* The Air Force program that implements part 7, section B (Human Systems Integration) of DoD Instruction 5000.2.

Incoming Reliability—The probability that a system or weapon will pass an incoming functional test (acceptance test) at the unit-level maintenance facility.

Inflight Engine Shutdown Rate—The number of times pilot shut down engines inflight due to engine or engine-related malfunctions per 1,000 engine flight hours.

Inherent Availability—The theoretical availability of a weapon or system isolated from its operational environment. Inherent availability is not an operational term and should not be used in operational requirements documents.

Integrated Combat Turnaround Time—The time required to service or rearm aircraft, starting when personnel first chock the aircraft and ending when the aircrew accepts it. When clocking this turnaround time, allow for simultaneous:

- Fueling.
- Loading and unloading.
- Mission data updating.
- General servicing.
- Maintenance.

Integrated Diagnostics—A structured total-system approach for designing the most effective combination of automated, semiautomated, and manual diagnostic resources. Such an approach gives the required performance information to the appropriate personnel and provides support mechanisms that efficiently isolate all faults to the specific malfunctioning item(s). ID seeks to unambiguously detect and isolate 100 percent of the known or expected system faults. ID maximizes diagnostic effectiveness by integrating seven elements:

- On-board mission environmental monitoring.
- Built-In Test (BIT) and Automatic Test Equipment (ATE).

- Portable Maintenance Aids (PMA).
- Reusable test data.
- CALS-compatibility.
- Electronic TOs.
- On-the-Job-Training (OJT) for maintenance personnel.

Integrated Diagnostics Effectiveness—A measure of a system's ability, through automated, semiautomated, and manual diagnostic resources, to:

- Give the operator a timely and understandable indication of any change in a system or mission-essential weapon function.
- Correlate and store all pertinent diagnostic data in a nonvolatile memory medium that operator and maintenance personnel can access on demand.
- Expedite the unambiguous isolation of any system or weapon malfunction to the defective part or item.
- Reduce the number of unconfirmed fault indicators such as CNDs and false alarms.

Launch from Combat Alert—The time required to launch an aircraft with cold systems (not powered up or operating). Time begins when the aircrew starts up the ladder and ends when they're ready to taxi the aircraft.

Life Unit—The generic term for a standard time or event based unit of measure against which operational conditions are evaluated. Life units include:

- Flying hours.
- Operating hours.
- Possessed hours.
- Sorties.
- Rounds.
- Mileage.
- Other calendar or clock time.
- Other recurring events.

Logistics Reliability—A measure of a system's ability to operate under the defined operational and support concepts using specific logistics resources such as physical labor and spares. Typical measures include:

- Mean time between maintenance.
- Mean time between demand.
- Mean time between removals.

NOTES: This term is also referred to as "logistics support frequency."

Logistics Requirements—These include operations, maintenance (including depot activities), training, and base operating support. Logistics encompasses the integrated logistics support (ILS) elements:

- Design interface.

- Maintenance planning.
- Support equipment.
- Supply support.
- Packaging, handling, storage, and transportation.
- Technical data.
- Facilities.
- Personnel.
- Training and training support.
- Computer resources support.

Maintainability—The ability of an item to be retained in, or restored to, a specified condition when maintenance is performed by personnel having specified skills using prescribed procedures and resources at each prescribed level of maintenance and repair.

Maintenance Action—An element of a maintenance event. One or more tasks taken to restore a system or maintain it in working order.

Maintenance Event—One or more preventive or corrective maintenance actions, including:

- Troubleshooting due to any type of failure or malfunction.
- Scheduled maintenance.
- Servicing.

Maintenance Event Time—The sum of unscheduled and scheduled maintenance action times spent on a specific maintenance event.

Maintenance Man-Hours per Life Unit—The maintenance hours required to support a system divided by the appropriate life unit.

Maintenance Turn Time—The time required to prepare a returning mission-capable aircraft for another sortie. This calculation takes into account:

- Servicing of fuel, oil, and oxygen.
- The "look" phase of through flight inspection.
- Launch preparation.

Manpower Spaces per System—Total on- and off-equipment maintenance staffing requirements per system including number of spaces and skill levels.

Mean Downtime—The average elapsed time between losing MC status and restoring the system to MC status.

Mission Area Plan (MAP)—This plan outlines an investment strategy to support the programming, requirements, laboratory, and independent research and development processes for a specific mission area or necessary subset.

Mission Capable (MC)—A system's ability to perform at least one of its assigned peacetime or wartime missions. If no wartime mission is assigned, the system must be capable of performing any one assigned mission. AFI 21-103 distinguishes:

- A fully MC (FMC) system as one which can perform all of its assigned peacetime and wartime missions.
- A partially MC (PMC) system as one which can perform at least one but not all of its assigned missions.
- A not MC (NMC) system as one which cannot perform any of its assigned missions.

Mission Effectiveness—The probability that a system is available to initiate its mission and will complete its mission when initiated. The calculation takes into account both the system's availability at the start of the mission and its reliability and dependability during a specified mission.

Mission-Essential Subsystem List (MESL)—A list of subsystems used to determine a system's FMC or PMC status. Each subsystem on the MESL serves as a required element of either a FMC or PMC system.

Mission Reliability—The probability that an available system or weapon will perform its required function at a specified mission time, in a specified environment, or during a scenario over the duration of a specified mission or over a specified number of sorties.

Mobility—A quality that permits military forces to move from place to place while fulfilling their primary mission. (Mobility requirements for a deploying unit are usually expressed as the number of C-141B load equivalents needed to move that unit. For a unit that doesn't deploy, but may disperse, the mobility requirements are expressed as the number and type of vehicles necessary to move the unit and support it at the dispersal site.)

Operational Availability—The availability of a weapon or system in its operational environment.

Operational Effectiveness—The overall degree of mission accomplishment of a system when used by representative personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, tactics, survivability, vulnerability, and threat.

Operational Suitability—The degree to which a system can be satisfactorily placed in field use, taking into account:

- Logistics and supportability.
- Availability, reliability, maintainability.
- Transportability.
- Interoperability.
- Wartime usage rates.
- Safety.
- Human factors.
- Compatibility.
- Natural environmental effects and impacts.
- Documentation.
- Training.

Power-On Post Load Check Time—The time needed to complete all functional checks after loading a weapon or system on the host.

Preventive Maintenance—The care and servicing of systems by personnel to maintain equipment and facilities in satisfactory operating condition by systematically inspecting, detecting, and correcting incipient failures either before they occur or before they develop into major defects.

Readiness—The ability of forces, units, weapon systems or equipment to deploy or employ without unacceptable delays and deliver the outputs they were designed to provide.

Reliability—The probability that a system and its parts will perform a mission without failure, degradation, or demand on the support system. (AFM 11-1)

Reliability Growth—The improvement in a reliability parameter caused by successfully correcting design or manufacturing deficiencies.

Repair Time—The corrective maintenance time required to return a system or part to operational status. (May be calculated as a mean or maximum repair time.) Repair time takes into account:

- Set-up.
- Access.
- Troubleshooting.
- Disassembly.
- Repair, reassembly, and repair verification.
- System test.
- Backout procedures.

Restoral Time—The maximum time allowed for restoring the mission essential functions of a system or weapon to mission-capable status. Also see MDT.

Retest OK or Bench Test Serviceable—A maintenance event involving a part or subsystem malfunction at the on-equipment maintenance level that personnel can't duplicate at the off-equipment maintenance level. As a result of this event, personnel may return the item to service without taking corrective action.

Scheduled Maintenance—Periodic inspection and servicing of equipment prescribed on a calendar, mileage, hours-of-operation, or other life unit basis.

Service Life—The length of time a system or component will remain operable in use.

Shelf Life—The length of time that an item of supply, subject to deterioration or having a limited life, remains serviceable while stored. See also "storage life."

Single Manager—The individual who is ultimately responsible and accountable for decisions, resources, and overall program execution relative to a materiel group, product group, or weapon system.

Software Error—A mistake that results in faulty software. Examples include instances where managers or programmers:

- Omit or misinterpret operational requirements in a software specification.
- Translate requirements incorrectly.
- Omit a requirement in the design specification.

Software Failure—The termination of the ability of a system to perform its required function as a result of a software defect. Software errors cause software faults. Software faults cause software failures.

Software Maintainability—A factor that depends on the inherent characteristics of software, as documented in manuals and source listings, to facilitate software modifications.

Software Maturity—A measure of the evolution of software toward satisfying operational requirements. The primary indicators of software maturity are the number and severity of required software changes.

Software Reliability—The probability that software will contribute to failure-free system performance for a specified time under specified conditions. The probability depends on information input into the system, system use, and the existence of software faults encountered during input.

Sortie Generation Rate—The average number of sorties produced per aircraft during a defined operating period.

Stock Availability—The probability that the resources specified for a system or weapon are available for use (not in the repair pipeline) over a storage life at a random points in time.

Storage Life—The length of time over which an item of supply (including explosives), given specific storage conditions, may remain serviceable and, if relevant, safe. See also "shelf life."

Subsystem Break Rate—The percentage of operable subsystems per sortie that experience critical failures when a sortie demand is placed on the host system.

Subsystem Utilization Rate—The percentage of time per sortie that the subsystem will operate, including time in standby mode.

Support Structure Vulnerability—The amount of space necessary to decrease the vulnerability of support base-level operational maintenance activities subject to attack.

Sustainability—A system's ability to maintain the necessary level and duration of operations to achieve military objectives. Sustainability depends on ready forces, materiel, and consumables in enough quantities and working order to support military efforts.

System Configuration and Loading Time—The time required to configure a mission-capable system or weapon for a specific mission. Begin clocking time when the loading or maintenance crew arrives at the system or weapon with necessary tools, accessories, software, and support equipment and stop when personnel complete the post load check.

System Deployability—The inherent characteristics of the system that satisfy any operational requirement for deployment. Deployability depends on system reliability, the characteristics of required maintenance equipment, the processes that support the flow of required spares and support equipment, and the maintenance concept. Express deployability in terms of airlift requirements for deploying initial and follow-on support elements, the number of personnel required for setting up and operating any equipment, and the amount of resupply.

System Independent Airlift Support—The amount and type of airlift required to support an independent squadron or unit for 30 days without additional support. Airlift support is usually expressed in numbers of 463L pallets or C-141B equivalents and consists of en route support teams, initial tactical support elements, readiness spares packages, support equipment, and so on. ***EXCEPTION:*** Airlift support doesn't include other support, such as fuels, munitions, medical, and food services.

Technical Data—Data that may include:

- Engineering drawings.
- Lists.
- Specifications.

- Standards.
- Process sheets.
- Manuals and documentation.
- Technical reports and orders.
- Catalog items.

Test, Analyze, and Fix—A disciplined process for systematically detecting and eliminating hardware or software defects during any phase of the equipment's life cycle.

Time Between Maintenance Events—The number of life units that pass between maintenance events.

Time Between Removals—The number of life units that pass between removals of a particular component or item or subsystem.

Time To Assemble and Prepare for Delivery—The time required to assemble and prepare a weapon or system for operational use.

Time To Restore Function—The time required to restore a mission function interrupted by a critical failure. (May be calculated using the mean or maximum time to restore a system.)

Time To Troubleshoot—The time required to unambiguously isolate a system fault.

Unconfirmed Fault Indications—The total number of faults that present themselves during the mission that the operator and aircrew either classify as false alarms or on-equipment maintenance personnel classify as CND.

Unscheduled Maintenance—Unplanned corrective maintenance required by unacceptable system or weapon conditions.

Utilization Rate—The average life units expended or missions launched or flown per system or subsystem over a specific interval.

Variability Reduction Process—A structured, disciplined design and manufacturing approach aimed at meeting customer expectations and improving the development, manufacturing, and repair processes while minimizing time and cost.

Vertical Testability—The inherent diagnostic capability at each level of maintenance that ensures that any malfunction isolated to a specific unit under test at one level of maintenance, can be replicated at any other maintenance level designed for that unit.

Wooden Round—A munitions item designed specifically to require little or no maintenance, inspection, or testing throughout the life cycle.

Attachment 2

INTEGRATED LOGISTICS SUPPORT (ILS) ELEMENTS

A2.1. Integrated Logistics Support (ILS):

A2.1.1. Responsibilities:

A2.1.1.1. MAJCOMs:

- Use this attachment to review the ILS elements and supportability and readiness concepts in developing operational and logistics requirements.
- Address and accept trade-offs between a system's various supportability and operational requirements.
- Tailor and refine ILS requirements throughout the system acquisition process to describe a viable support concept for the system.
- Define qualitative and quantitative operational RM&D thresholds and objectives as precisely as possible.
- Continually refine RM&D parameters throughout the acquisition process as the overall system design matures.
- Use attachments 3 through 10 for supportability measures to use when developing quantitative RM&D requirements relevant to specific systems.

A2.1.1.2. SMs establish an Integrated Logistics Support Management Team (ILSMT) whose membership includes multicommand users, developers, and testers.

A2.1.1.3. ILSMTs address each of the ILS elements and carry out the actions associated with each element. See the Air Force Acquisition Model (AFAM) for a more complete discussion of specific ILS tasks.

A2.2. Integrated Logistics Support (ILS) Elements:

A2.2.1. Design Interface. This ILS element integrates the logistics-related readiness, combat capability, and supportability design parameters into system and equipment design. The factors listed in figure A2.1 collectively affect the testing, operation, support, and costs of our weapons systems.

Figure A2.1. Readiness, Combat Capability, and Supportability Design Parameters.

- Reliability, maintainability, and deployability.
- Sustainability.
- Standardization and interoperability.
- Fuel, utility and energy management.
- Testability.
- Dependability.
- Transportability.
- Durability.
- Availability.
- Survivability.
- Integrated diagnostics effectiveness
- Transportability.
- Accessability.
- Spares support.
- Mission effectiveness.
- Serviceability.

- Software reprogrammability.
- Level of repair.
- Industrial support base.
- Support equipment.
- Inspections.
- Human factors.
- Corrosion.
- Physical obsolescence.
- Hazardous material management.
- Software speed and efficiency.
- Calibration.
- Revised tactics.
- Training.
- Manpower.
- System safety.
- Nondestructive inspection.
- Changes in threat environment.
- Mobility.

A2.2.2. Maintenance Planning. Address the requirements and constraints inherent in on-equipment, organizational off-equipment, and off-equipment maintenance for operational and supporting commands. Consider the entire life cycle of the system, including its requirements during peacetime, wartime, and other contingency scenarios.

A2.2.2.1. Describe the operational maintenance environment for the total (scheduled and unscheduled) maintenance effort, including:

- Basing concept.
- Expected weather and climate (consider all weather to accommodate mobility).
- Acceptable frequencies and repair times including ease, accessibility, and troubleshooting.

A2.2.2.2. Specify levels and organizations responsible for maintenance. Evaluate two levels of maintenance as a design, development, and contracting goal in all acquisition programs to the extent repair level analysis and logistics support analysis data and program management action support such a decision.

A2.2.2.3. Specify an acceptable interservice, organic, or contractor mix. Ensure that planning includes contractor participation in fielded operations if contractor support is anticipated.

A2.2.2.4. List the generic type of maintenance tasks these organizations will perform. Include workload and time phasing for depot maintenance requirements. Consider the use of organic depots for modifying fielded systems.

A2.2.2.5. Assess the need for, or intention to perform, centralized repair at selected operating sites or at safe areas. Include requirements for battle damage repair.

A2.2.2.6. Address maintenance constraints posed by requirements for:

- The physical make-up of the equipment.
- Electronics.
- Chemicals.
- Nuclear hardness.
- Survivability.
- Safety.
- Occupational health.
- Environment.

A2.2.2.7. Include requirements for demilitarization and redistribution.

A2.2.2.8. Express the requirement for a tailored logistics support analysis (LSA) according to MIL-STD-1388-1A/2B. When drafting this analysis:

- Define, develop, and influence supportability-related design factors.
- Ensure that personnel develop and field a fully integrated system support structure at the same time as they field the prime mission equipment.

A2.2.2.9. In the LSA process, consider requirements for:

- Spares.
- Technical orders.
- Support equipment.
- Special facilities.
- Skill levels.
- Specialized training.
- Other pertinent ILS areas.

A2.2.2.10. Where appropriate, consider compatibility with systems that transmit on-aircraft or system faults to base-level management information systems.

A2.2.2.11. Consider using expert systems to help reduce data and filter fault data down to a manageable level. ***NOTE:*** Such expert systems also carry a full range of ILS requirements that you must address.

A2.2.2.12. The software support concept can affect significantly both mission capability and system operating and support costs. If you require changes to software:

- Consider how to implement them at the operational unit level and what manpower, training, equipment, and documentation you need to accomplish the task.
- Ensure that all reprogrammable items in the end item have as many of the same design interfaces as possible for uploading new or changed software. When possible, ensure that all items share the same protocols, data buses, architecture, power levels, pin connections, connector types, and so on.
- Consider ways to distribute software changes.

A2.2.3. Support Equipment (SE). SE includes:

- Transportation, ground handling and maintenance equipment.
- Munitions maintenance equipment.
- Special and common tools.
- Metrology and calibration equipment.
- Aircraft battle damage repair kits.
- Test and diagnostic equipment.
- Software support and reprogramming equipment.
- Automatic test equipment.

- Computer programs.

A2.2.3.1. Consider IMPACTS when designing and modifying SE. Correlate the SE requirement with the maintenance concept and identify SE development constraints. Ensure that the SE is supportable and meets the timing and calibration requirements necessary to maintain the systems.

A2.2.3.2. Standardize equipment or make it compatible with other systems or equipment. Consider a design that incorporates common support equipment.

A2.2.3.3. Schedule SE development in phases that correlate with the development of the prime mission equipment, when possible.

A2.2.3.4. Specify SE design limitations and requirements, such as:

- RM&D parameters.
- Size, weight, and power.
- Complexity, safety, and calibration.
- Test tolerance consistency and self-test features.
- Required manpower skills and levels.
- Repair tools.
- Climatic operational environment.
- Equipment performance, mobility, transportability, service life, and user operational test and evaluation (OT&E).

A2.2.3.5. Determine warranty requirements for SE under development and SE undergoing modification, if appropriate.

A2.2.3.6. Explain any preference for using SE instead of built-in test and integrated diagnostics within the mission equipment design.

A2.2.3.7. Indicate whether you'll accept commercial off-the-shelf equipment.

A2.2.3.8. Consider:

- Integrated test and diagnostic software.
- Download capabilities for both software and hardware.

A2.2.3.9. Base your decision either to deploy standard SE for each subsystem at remote operating locations or develop integrated SE capabilities for the weapons systems.

A2.2.3.10. Consider what equipment and software tools you'll need for software support, including support equipment that sends and receives software changes. Use the existing and planned tools whenever practical. When possible use the same tools that were used during software development.

A2.2.3.11. Consider the impact of support equipment availability on:

- The force structure of large active duty units.
- Squadrons split due to mobilization.
- Smaller, geographically separated Air Reserve Component (ARC) units. (For example, active-duty fighter wings of 72 aircraft often have two pieces of support equipment for

three aircraft squadrons. When those three squadrons move to three separate ARC locations, only two can take SEs with them.)

A2.2.3.12. Develop firm requirements and goals for reducing the impact of support equipment on:

- Deployment footprints.
- Logistics support tails.
- Logistics system infrastructure vulnerabilities.

A2.2.3.13. Consider the need for SE to conduct nondestructive inspections and oil analyses.

A2.2.3.14. Consider special SE needs for space systems such as tools to repair a satellite while on orbit.

A2.2.4. Supply Support. Specify the importance of the sparing concept to RM&D requirements as documented in the LSAR taking into account:

- Peacetime and wartime operations and maintenance concepts.
- Primary operating stocks and readiness spares support concepts.

A2.2.4.1. MAJCOMs define wartime assignments based on RSPs and IRSPs in terms of:

- Deployability (deployment footprint and associated support tail).
- Maintenance concepts.
- Operations tempo.
- Days of support without resupply.
- Peculiar mission requirements of each organization.

A2.2.4.2. SMs develop a provisioning strategy and plan that balances best value, producibility, reliability, the industrial base, procurement lead times, availability of vendor provided spares, and the adequacy of commercial data needed to identify replacement parts. Consider these factors when planning for:

- Preoperational spares support.
- Government and contractor-furnished equipment programs.
- Direct purchase, breakout, and competition.
- Data acquisition.
- Initial and replenishment provisioning.
- Contractor support.

A2.2.4.3. SMs ensure adequate funding for:

- Provisioning technical documentation.
- Spares acquisition integrated with production.
- Reprocurement data that support competitive replenishment spares acquisition.
- Long-term spares support for nondevelopmental or commercial off-the-shelf items.

A2.2.4.4. MAJCOMs and SMs consider energy requirements in system design, especially systems operated under austere conditions in deployed locations. Consider requirements for:

- Standby emergency power.
- Liquid oxygen or nitrogen.
- Hydraulic fluids.
- Electricity.
- Multi-fuel and synthetic fuel.
- Energy storage.

A2.2.5. Packaging, Handling, Storage, and Transportation (PHS&T). Specify PHS&T requirements to ensure that personnel package, transport, preserve, protect, and properly handle all systems, equipment, and support items.

A2.2.5.1. Consider:

- Geographical and environmental restrictions.
- Electrostatic discharge-sensitive and hazardous materiel PHS&T requirements.
- Standard handling equipment and procedures.

A2.2.5.2. Specify development and procurement plans for systems, equipment, and munitions so that existing or programmed commercial or military transportation facilities can accommodate their gross weights and dimensions. Require a search of the Container Design Retrieval System for suitable existing containers before developing new ones.

A2.2.5.3. Minimize the deployment footprint, particularly for outsized airlift.

A2.2.5.4. For equipment approaching the dimensions of an international standards organization (ISO) container, specify design and building requirements so that individual or mated ISO containers can accommodate the equipment. Factors to consider are shown in figure A2.2.

Figure A2.2. Packaging, Handling, Storage, and Transportation Factors.

- Transportability criteria.
- Sectionalization.
- Requirements for special permits.
- Airlift requirements.
- Highway standards.
- Safety.
- Fragile, sensitive, or hazardous material requirements.
- Gross weight and dimensions.
- Standardization requirements.
- Shelter and van requirements.
- Packaging protection levels.
- Transportability test requirements.
- Environmental criteria and constraints.

A2.2.5.5. Clarify mobility, deployability, and transportability requirements. For example, specify maximum allowable cubic dimensions per load or pallet and maximum number of loads or pallets to support the design reference mission profile. Calculate pallet dimensions to ensure that airlift is flexible and compatible with available logistics transportation within theaters of employment.

A2.2.5.6. Specify the maximum time permitted to prepare for deployment and set up on arrival (consider both movement preparation and assembly time) at austere and improved sites, if applicable. Many items, such as tactical shelters, large vehicles, and aerospace ground equipment, require extensive preparation and reassembly times.

A2.2.5.7. State requirements for specialized (environmental), internodal, or tactical shelter containers and container handling equipment to support mobility operations. If mobility is required, specify the requirement and identify limitations. For example, state that personnel must be able to transport an item in fielded military design vehicles or airlift them in road mobile configuration.

A2.2.5.8. For missiles, munitions, and other items as appropriate, address:

- Shelf life.
- Service life.
- Quantity-distance criteria.
- Other storage, mobility, and transportation characteristics, such as how to reprogram missiles stored in containers and loaded on aircraft.

A2.2.5.9. Consider alternatives that could improve PHS&T efficiency, such as system or subsystem design modularity and standardization.

A2.2.6. Technical Data:

A2.2.6.1. Describe unique requirements for developing and distributing technical data.

A2.2.6.2. Ensure that the requirements for technical data match the maintenance concept.

A2.2.6.3. Require delivery of digital data to satisfy computer-aided acquisition and logistics support (CALS) initiatives and standards according to MIL-STD-1840B and MIL-R-28002B.

A2.2.6.4. Consider using automated technical orders when feasible. Require delivery of data on aperture cards or paper only when this method is more economical.

A2.2.6.5. Validate and verify technical data to support, operate, and maintain systems and equipment in the required state of readiness.

A2.2.6.6. Evaluate commercial manuals or technical data from other services, if appropriate, and decide whether these give adequate information.

A2.2.6.7. Consider backup methodologies for archiving technical data to protect it from destruction during disasters.

A2.2.7. Facilities:

A2.2.7.1. Consider the full spectrum of Air Force facility engineering responsibilities, including:

- Environmental analysis.
- Programming.
- Design.
- Facility acquisition.

A2.2.7.2. Identify the facility constraints, including support facility requirements that may apply.

A2.2.7.3. Specify whether the system or equipment needs new facilities or must be designed to fit existing facilities. Give specific utility requirements.

A2.2.7.4. Identify the impact of the new facility on existing facilities including airfield pavements.

A2.2.7.5. Minimize the combat support structure's vulnerability to attack by reducing the number and size of new facilities needed by the system.

A2.2.7.6. Consider explosives hazards and site licensing requirements, as applicable.

A2.2.8. Manpower and Personnel:

A2.2.8.1. Specify both quantitative and qualitative manpower requirements.

A2.2.8.2. Establish personnel requirements based on operations and support tasks, their frequency, and the planned future force structure.

A2.2.8.3. Specify:

- Number of manpower authorizations.
- The desired mix of officers, enlisted personnel, civilian employees, Air Reserve technicians, and contractors.
- The Air Force specialty code structure.
- The desired distribution of skill levels.
- Sources of specialists.
- The facility's projected impact on the draw-down system.

A2.2.8.4. Manpower and personnel requirements encompass:

- Wartime scenarios.
- Projected manpower budgets.
- System training plans.
- Potential safety and health hazards.
- The effect of planned work loads on operators and maintenance personnel (including software support personnel) in the operational environment.

A2.2.8.5. AFI 63-117, *Integrated Manpower, Personnel, and Comprehensive Training and Safety (IMPACTS) Program*, provides a framework to address and integrate all the human elements of manpower, personnel, training, safety, and health. Each IMPACTS element affects weapon system cost, schedule, design, and performance.

A2.2.9. Training and Training Support:

A2.2.9.1. Specify the training concept to include:

- Aircrew, operator, and maintenance training.
- Its relationship to training for existing systems.
- Using mockups, simulators, and training aids.

A2.2.9.2. Emphasize the need to establish a multicommand training and planning team and prepare a life-cycle training development plan according to AFI 36-2201.

A2.2.9.3. Coordinate scheduling with MAJCOMs and Air Education and Training Command (AETC) Headquarters, to ensure that using and maintenance personnel (including software support personnel) receive training when the equipment arrives onsite.

A2.2.9.4. Address training needs, including:

- Civilian (depot), active duty, and reserve personnel training.
- Individual and crew training.
- New equipment training.
- Initial, formal, and on-the-job training.

A2.2.9.5. Develop a training program that:

- Integrates weapon system design, operational concepts, employment environments, and current maintenance concepts.
- Encompasses the full training spectrum, including on- and off-equipment maintenance at all applicable maintenance levels.
- Uses the Air Force standard system for computer-based training.
- Addresses training for personnel with site activation and initial cadre responsibilities.
- Includes training to support:
- Organic course development.
- Development tests and evaluations.
- Initial operational test and evaluation team training requirements.

A2.2.9.6. Identify responsibilities of the Air Force and the contractor for developing and conducting each phase of training.

A2.2.9.7. Consider structuring annual training courses for ARC members who have limited time available.

A2.2.9.8. Include required training equipment for inventory items, prime-mission equipment, support equipment, and training devices.

A2.2.9.9. Address:

- Logistics support for training equipment and devices.
- Projected equipment type, number, required location , and interim training support provisions.
- Additional facility or manpower requirements necessary to support projected training and training devices.
- IMPACTS application and warranty considerations when designing and modifying training equipment.

A2.2.10. Computer Resources Support:

A2.2.10.1. Consider system requirements and design constraints within the context of the support concepts.

A2.2.10.2. Describe specific requirements and constraints pertaining to computer programs and associated documentation, related software, source data, facilities, hardware, firmware, manpower, personnel, and other factors required to operate and support mission-critical computer systems. Make sure that the system can support and use the software in the operational environment when the system is delivered.

A2.2.10.3. Specify the level of MAJCOM involvement and control of mission software and data. Identify requirements for configuration management and software quality control for using and supporting commands.

A2.2.10.4. Consider using spare memory loader verifiers (MLV) memory storage media and blank or programmed firmware devices to accommodate multiple software configurations to meet mission requirements.

A2.2.10.5. When appropriate and cost effective, consider a one-time, lifetime buy of microcircuits if reasonably certain that the specific technology will become obsolete within a system's lifetime.

A2.2.10.6. Outline required interfaces. Include message formats for data sharing between systems, human-machine interfaces, and interaction among subsystems. Identify other systems that may need to adapt to new requirements. If feasible, consider identifying standardized interfaces across various weapon systems to enhance the operations and support efficiency.

A2.2.10.7. Specify interfaces to the Automatic Digital Network, Defense Data Network, or other networks.

A2.2.10.8. Identify requirements for:

- Spare memory.
- Spare throughput.
- Computer memory growth.
- Software partitioning.
- Modular design.
- Software module size.

A2.2.10.9. Outline constraints such as operating environment, package limitations, standards (including higher order language, architecture, modularity, and MLV), required reliability, separation of mission data from the operating systems, and partitioning required to meet operational needs.

A2.2.10.10. Specify required reaction times for all support agencies. Tell them how long they have to respond after receiving change requirement notices and before receiving software or firmware changes by operational unit.

A2.2.10.11. Specify maximum time allowed between software updates, corollary test program set updates, and automatic test equipment updates.

A2.2.10.12. Specify requirements for reprogramming software. Specify when personnel need to upload software in all of an end item's reprogrammable components for peacetime and wartime configurations.

A2.2.10.13. Address requirements for:

- Computer system security.

- Sensitive information protection.
- The integrity of critical processing.
- Support software such as compilers, simulators, emulators, and software development or support tools.

Attachment 3

AIRCRAFT SYSTEMS SUPPORTABILITY MEASURES

A3.1. Availability and Sustainability. MAJCOMs must consider the availability and sustainability measures when describing top-level logistics requirements for aircraft systems. Use the equations in this attachment to develop these measures.

A3.1.1. Mission-Capable (MC) Rate. Use the MC rate to measure how long, in percent of possessed time, a system can perform at least one of its assigned missions.

A3.1.1.1. Base the MC rate on the sum of the fully mission capable (FMC) and partially mission capable (PMC) rates. Express this calculation as:

A3.1.1.2. The overall MC requirement describes different design missions, the expected percentages of equipment use, and the desired MC rate for each mission.

$$\mathbf{MC = FMC+PMC}$$

A3.1.1.3. PMC status indicates that an aircraft can perform at least one of its assigned missions. You may report a multimission aircraft as PMC even if it is unable to accomplish its primary mission.

A3.1.1.4. Report FMC and PMC rates via the status reporting system according to AFI 21-103.

A3.1.1.5. MC rate has some limitations. It varies with use during a given calendar period of time so that the more a system operates, the more it goes down for corrective and preventive maintenance. MC rate doesn't accurately account for preventive maintenance efforts.

A3.1.2. Utilization Rate (UR). Use UR to measure the average life units that pass per system during a specific period.

A3.1.2.1. Express UR as flight hours or sorties per aircraft per relevant period of time, such as a day or month. Calculate the value by averaging the flight hours or sorties during the measurement period and dividing this figure by the average number of possessed aircraft (during peacetime) or authorized aircraft (during wartime). Express this calculation as:

$$\text{Daily Wartime Sortie UR} = \frac{\text{Average number of sorties per day}}{\text{Average number of aircraft authorized}}$$

A3.1.2.2. Establish required or planned peacetime and wartime UR values.

A3.1.3. Essential System Repair Time per Flight Hour (ESRT/FH). Use ESRT/FH to compare clock time needed to repair mission-essential equipment and operating time measured in flying hours.

A3.1.3.1. ESRT/FH addresses both corrective maintenance (CM) and preventive maintenance (PM) performed on mission-essential equipment. This measurement pertains only to full system list (FSL) equipment. Express this calculation as:

$$\text{ESRT/FH} = \frac{\text{Elapsed PM + Elapsed CM}}{\text{Flight Hours}}$$

A3.2. Mission Reliability. MAJCOMs must consider mission reliability measures to describe top-level logistics requirements for aircraft systems.

A3.2.1. Weapon System Reliability (WSR). Use WSR to measure the probability that a system with a record of completing a specified mission will continue to do so.

A3.2.1.1. Compute the value of WSR by dividing the number of missions completed successfully by the number of missions attempted.

A3.2.1.2. Define "mission" in terms of start-to-finish criteria. Factor in the effect of crew changes. Relate the success of the mission to the satisfactory performance of mission-essential items during the mission.

A3.2.1.3. Base WSR on a mission design reference profile to allow for translation of WSR into contractual requirements.

A3.2.1.4. Determine functional profiles for storage, build-up, preflight, takeoff, ingress, over-target, weapons delivery, egress, landing, and shutdown. Determine environmental profiles such as temperature, air density, humidity, vibration, shock, corrosive agents. Determine mission critical systems for these profiles.

A3.2.1.5. Establish a single peacetime and wartime WSR value for each given mission. ***EXCEPTION:*** If the peacetime mission length differs significantly from the wartime mission length, establish two values for WSR. Where you specify more than one type of mission, give the percentage of time over which you intend to use the equipment and the desired WSR for each mission.

A3.2.2. Break Rate. Use break rate to measure the percentage of sorties from which an aircraft returns with an inoperable mission-essential system that was previously operable. Break rate includes "code 3" conditions, such as ground and air aborts.

A3.2.2.1. Measure the break rate by dividing the number of missions flown by the number of "code 3" events. Express this calculation as:

$$\text{Breakrate (\%)} = \frac{\text{Number of aircraft breaks during measurement period}}{\text{Number of sorties flown during period}} \times 100$$

A3.2.3. Combat Rate. Use the combat rate to measure the average number of consecutively scheduled missions flown before aircraft experience critical failures.

A3.2.3.1. Combat rate reflects the philosophy that scheduling and completing a mission is more important than changing it mid-flight because of equipment failures. Express this measure of mission reliability as:

$$\text{Combat Rate} = \frac{\text{Number of successful sorties flown}}{\text{Number of Scheduled missions} - \text{Number of ground aborts} - \text{Number of air aborts}}$$

A3.2.4. Mean Time Between Critical Failure (MTBCF). Use MTBCF to measure the average time between failures of mission-essential system functions.

A3.2.4.1. Critical failures occur when mission essential systems become inoperable or operate outside their specified range of performance. MTBCF includes all hardware and software critical failures that occur during mission and non-mission time. Express MTBCF as:

$$MTBCF = \frac{\text{Number of operating hours}}{\text{Number of critical failures}}$$

A3.3. Logistics Reliability. MAJCOMs must consider logistics reliability measures when describing top-level logistic requirements for aircraft systems.

A3.3.1. Mean Time Between Maintenance (MTBM). Use MTBM to measure the average life units between maintenance events, including scheduled and unscheduled events.

A3.3.1.1. Use flying hours as the life units for aircraft. Select an appropriate MTBM parameter based on MAJCOM requirements. Current and planned information systems permit tracking of standard MTBM parameters, such as:

- MTBM (inherent malfunctions).
- MTBM (induced malfunctions).
- MTBM (no-defect events).
- MTBM (total corrective events).
- MTBM (preventive maintenance).
- MTBR (mean time between removal for cause).
- MTBD (mean time between demand).

A3.3.1.2. Specify peacetime and wartime values for MTBM, since equipment used during these periods may differ.

A3.4. Maintainability. MAJCOMs must consider maintainability measures when describing top-level logistics requirements for aircraft systems.

A3.4.1. Mean Downtime (MDT). Use MDT to measure the average elapsed time between losing MC status and restoring the system to MC status.

A3.4.1.1. MDT quantifies the clock time required to return the system to at least PMC status. Downtime includes:

- On-equipment (and in some instances off-equipment) repair labor time.
- Nonlabor time, such as cure time for composites.
- Maintenance and supply response time.
- Administrative delays.
- Time for other activities that result in NMC status such as:
- Training.
- Preventive maintenance.

A3.4.1.2. MDT also takes into account field conditions, such as:

- Technical order (TO) availability and adequacy.
- Support equipment capability.
- Availability, supply levels, and manning (including experience level and structure of duty shifts).

A3.4.1.3. MDT mainly addresses unscheduled maintenance, but it can also include scheduled maintenance, such as scheduled inspections. Develop a single peacetime and wartime value for MDT. ***EXCEPTION:*** When you expect maintenance or support conditions in wartime to differ significantly from those in peacetime, describe those differences and describe separate values for MDT.

A3.4.2. Fix Rate. Use fix rate to calculate the percentage of aircraft that return as "code 3" and must be returned to MC status within a specified amount of time (for example, 70 percent in 4 hours or 85 percent in 8 hours).

A3.4.2.1. The time requirement for fix rate includes direct maintenance time and downtime associated with administrative and logistics delays. Express fix rate as:

$$\text{Fix Rate} = \frac{\text{Number of aircraft fixed within “X” hours}}{\text{Total number of broken aircraft}}$$

A3.4.3. Mean Repair Time (MRT). Use MRT to measure the average on-equipment or off-equipment corrective maintenance time in an operational environment. State MRT requirements for on-equipment at the system level and for off-equipment at the line replaceable unit (LRU) level.

A3.4.3.1. MRT starts when the technician arrives at the aircraft site for on-equipment maintenance or receives the LRU at the off-equipment repair location. MRT includes all necessary corrective maintenance actions, such as:

- Test preparation.
- Troubleshooting.
- Removing and replacing parts.
- Repairing.
- Adjusting.
- Checking functions.
- Curing.

EXCEPTION: Don't include maintenance or supply delays in MRT calculations.

A3.4.3.2. Express MRT as:

$$\text{MRT (on - equipment)} = \frac{\text{Total on - equipment corrective maintenance time}}{\text{Total number of on - equipment maintenance events}}$$

NOTE: Don't confuse MRT, an operational term, with the contractual term, MTTR.

A3.5. Integrated Diagnostics. See attachment **Error! Bookmark not defined.**.

A3.6. Software. See attachment **Error! Bookmark not defined.**.

A3.7. Manpower. MAJCOMs must consider manpower measures when describing top-level logistics requirements for aircraft systems.

A3.7.1. Maintenance Man-Hours per Life Unit (MMH/LU). MAJCOMs base maintenance man-hours per flying hour (MMH/FH) on their specific needs. Current and planned maintenance information systems permit tracking:

- MMH/FH support, general (work unit code (WUC) 01-09).
- MMH/FH, corrective (WUC 11-99) for inherent malfunctions, induced malfunctions, no-defect actions, or total events.
- MMH/FH product improvement (time compliance technical order [TCTO]).
- MMH/FH preventive maintenance (time change items).
- MMH/FH, all categories totaled.

A3.7.1.1. Specify MMH/FH peacetime and wartime value, since equipment usage, maintenance needs, and support concepts may differ during these periods.

A3.7.2. Maintenance Personnel per Operational Unit (MP/U). Use MP/U to measure the total number of direct maintenance personnel needed for each specified operational unit to perform direct on-equipment and off-equipment maintenance. Develop manpower projections to support specified operating and maintenance concepts, taking into consideration basing, deployment, and operational scenarios.

A3.7.2.1. MP/U calculations include direct on-equipment and off-equipment maintenance personnel and specialties related to direct on-equipment and off-equipment support, such as structural repair (including sheet metal and composites) and nondestructive inspection. When analyzing manpower requirements, MAJCOMs should consider and use projected MC, PMC, MRT, and MTBM rates, coupled with aircraft battle damage repair analyses to determine overall manpower needs.

A3.7.2.2. MP/U calculations exclude:

- Unit deputy chief of maintenance staff agencies.
- Command section operations and support personnel.
- Powered SE support personnel.
- Munitions supply and missile maintenance personnel.

A3.8. Deployability. MAJCOMs must take into account deployability considerations in describing top-level requirements for aircraft systems. Address:

- Whether the system can be deployed to the theater of operations within the constraints of the user defined requirements.
- Maintenance planning factors:
- Manpower.
- Interoperability.
- Compatibility.

- Environmental concerns.
- Safety.
- Maintenance facilities.
- Depot support.

A3.8.1. Deployment Footprint. A system's deployment footprint defines the manpower, materiel, and equipment required to initially support the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. As a basis of measure, use, for example, equivalent pallet positions. See DoD Instruction 5000.2, part 6, section C, for an outline of the requirements for a design reference mission profile.

A3.8.2. Logistics Support Tail. A system's logistics support tail defines the manpower, materiel, and equipment required to sustain the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. Logistics support requirements must account for all manpower, materiel, and equipment directly or indirectly associated with the weapon system under consideration. For example, low reliable, mission critical systems require high levels of support (manpower and supplies) to sustain the mission over a given period of time.

Attachment 4

STRATEGIC OR TACTICAL GROUND-LAUNCHED MISSILE SUPPORTABILITY MEASURES

A4.1. Availability and Sustainability. MAJCOMs must consider availability and sustainability measures when describing top-level logistics requirements for strategic or tactical ground-launched missile systems. Use the equations in this attachment to develop these measures.

A4.1.1. Mission-Capable (MC) Rate. Use MC rate to calculate the percentage of possessed time, that a weapon system can perform its assigned mission.

A4.1.1.1. MC rate is defined as the combination of the FMC and PMC rates. It can be obtained using the status reporting system defined in AFI 21-103. MC rate is equal to the number of alert hours divided by PHs. Express MC as:

$$MC = \frac{\text{Alert hours}}{\text{PH}} = FMC + PMC$$

NOTE: Since these systems offer little or no repeat mission capability, calculate a single MC requirement for both peacetime and wartime.

A4.2. Mission Reliability. MAJCOMs must consider mission reliability measures that describe top-level logistics requirements for strategic or tactical ground-launched missile systems.

A4.2.1. Weapon System Reliability (WSR). Use WSR to measure the probability that a given system in MC status will successfully complete its designated mission or function.

A4.2.1.1. Operational commands base WSR on their specific requirements. For intercontinental ballistic missile (ICBM) systems, WSR gives the probability that an ICBM, launched in reaction to a valid execution order, will deliver a warhead that will detonate as planned in the target area. Apply a single peacetime or wartime WRS value. For example:

WSR = SAR x COMR x LR x IFR x RSR

where:

- SAR represents the probability that a deployed missile can react to a valid launch order. It is based on the ratio of FMC missile hours to total missile hours available.
- COMR represents the probability that a combat crew in the deployed force will receive a transmitted launch order. It doesn't take into account enemy action.
- LR represents the probability that an MC missile will launch as planned and that the ancillary equipment functions properly. It doesn't take into account enemy action.
- IFR represents the probability that a launched missile will properly signal a re-entry vehicle and place it in the correct ballistic trajectory so that it impacts in the target area.
- RSR represents the probability that a properly positioned re-entry subsystem will successfully deploy a re-entry vehicle so that it detonates a warhead in the target area.

A4.2.2. Mean Time Between Maintenance (MTBM). Use MTBM to measure the average life units between maintenance events, as the using command defines them. Use PHs as the time base for missiles.

A4.2.2.1. PHs may include time in which the system is not operating or is in a storage or dormant condition. Current and planned maintenance information systems permit tracking of several MTBM parameters including:

- MTBM (inherent malfunctions).
- MTBM (induced malfunctions).
- MTBM (no-defect events).
- MTBM (total corrective events).
- MTBM (preventive maintenance).
- MTBR (mean time between removal).

A4.2.2.2. Specify the same peacetime and wartime value for MTBM and MTBR. If possible, use a standard term. Use an appropriate MTBM or MTBR parameter based on specific MAJCOM needs.

A4.3. Logistics Reliability. MAJCOMs must consider logistics reliability measures when describing top-level logistics requirements for strategic or tactical ground-launched missile systems.

A4.3.1. Mean Downtime (MDT). Use MDT to measure the average elapsed time between losing MC status and restoring the system to MC status.

A4.3.1.1. MDT quantifies the clock time required to return a system to at least PMC status. The downtime clock continues to run until maintenance personnel return the system to at least PMC status. Downtime includes:

- Maintenance and supply response.
- Administrative delays.
- Actual on-equipment repair.
- Activities that result in NMC status, such as:
- Training.
- Preventive maintenance.

A4.3.1.2. When computing MDT, also consider:

- TO availability and adequacy.
- Support equipment capability and availability.
- Supply levels.
- Manning.
- Experience levels.
- Shift structure.

A4.3.1.3. Specify a single peacetime and wartime MDT value. ***NOTE:*** Don't confuse MDT, which describes an operational environment, with MTTR, which is used as a contractual term.

A4.4. Maintainability. MAJCOMs must consider maintainability measures when describing top-level logistics requirements for strategic or tactical ground-launched missile systems.

A4.4.1. Mean Repair Time (MRT). Use MRT to measure the average on-equipment or off-equipment corrective maintenance time in an operational environment. State MRT needs for on-equipment at the system level and off-equipment at the LRU level.

A4.4.1.1. MRT starts when the technician arrives at the missile site for on-equipment maintenance or receives the LRU at the off-equipment repair location. The time includes all maintenance done to correct the malfunction, including:

- Preparing for tests.
- Troubleshooting.
- Removing and replacing parts.
- Repairing.
- Adjusting.
- Conducting functional checks.

EXCEPTION: Don't include maintenance or supply delays in MRT calculations. ***NOTE:*** Don't confuse MRT, an operational term, with MTTR, which is used as a contractual term.

A4.4.1.2. Express MRT as:

$$\text{MRT (on - equipment)} = \frac{\text{Total on - equipment corrective maintenance time}}{\text{Total number of on - equipment maintenance events}}$$

A4.5. Integrated Diagnostics. See attachment **Error! Bookmark not defined.**.

A4.6. Software. See attachment **Error! Bookmark not defined.**.

A4.7. Manpower. MAJCOMs must consider manpower measures when describing top-level logistics requirements for strategic or tactical ground-launched missile systems.

A4.7.1. Maintenance Man-Hours per Life Unit (MMH/LU). Use MMH/LU to measure the average man-hours per life unit needed to maintain a system. Base missile time on PHs, in most cases.

A4.7.1.1. Current and planned maintenance information systems permit tracking of several standard maintenance man-hours per possessed hours (MMH/PH) terms, including:

- MM/PH support general (WUC 01-09).
- MMH/PH corrective (WUC 11-99) for inherent malfunctions, induced malfunctions, no-defect actions, or total events.
- MMH/PH product improvement (TCTO).
- MMH/PH preventive maintenance (time change items).
- MMH/PH total of above categories.

A4.7.1.2. Establish a single required peacetime and wartime value. Use an appropriate MMH/LU based on specific MAJCOM needs. The above example uses PHs as the life unit, but this is not required.

A4.7.2. Maintenance Personnel per Operational Unit (MP/U). Use MP/U to calculate the number of maintenance personnel needed to support an operational unit under specified operating and maintenance concepts. Develop manpower projections to support operating and maintenance concepts. *EXCEPTION:* Don't include depot-level personnel and other manpower excluded by AFI 38-201 when calculating MP/U.

A4.7.2.1. Specify peacetime and wartime levels of manning for ARC maintenance organizations. Peacetime MP/U reflects the number of full-time personnel needed to support daily peacetime flying operations. Wartime MP/U includes full-time and traditional reservists and is normally identical to the MP/U established by the gaining MAJCOM for a similar unit.

Attachment 5

AIR-LAUNCHED MISSILES, MUNITIONS, AND PODS SUPPORTABILITY MEASURES

A5.1. Availability and Sustainability. MAJCOMs must consider availability and sustainability measures when describing top-level logistics requirements for air-launched missiles, munitions, and pods systems. Use the equations in this attachment to develop these measures.

A5.1.1. Mission Capable (MC) Rate. Use MC rate to measure the percentage of possessed time that a system can perform any of its assigned missions. Establish required MC values for specific missions at the wartime utilization or sortie rate.

A5.1.1.1. MC applies only to items inspected periodically, such as short-range attack missiles and air-to-air missiles. Calculate the value of MC for some items using the sum of FMC and PMC rates. In such cases, express MC as:

MC = FMC + PMC

NOTE:

Use MC rate only for systems that can be tracked according to AFI 21-103 or similar reporting systems.

A5.1.2. Availability Measurement. At wing level, use availability to calculate the percentage of possessed or authorized equipment that can perform intended functions.

A5.1.2.1. Use the term "availability" in place of MC rate for systems not tracked by a status-reporting system. For example, apply the term "availability" to the quantity of possessed equipment, which is tracked only through an inventory-reporting system. Specify a single peacetime and wartime value of availability, with associated time and condition criteria.

A5.2. Mission and Logistics Reliability. MAJCOMs must consider the mission and logistics reliability measures when they describe top-level requirements for air-launched missiles, munitions, and pods systems.

A5.2.1. Weapon System Reliability (WSR). Use WSR to measure the probability that an available or MC weapon system will successfully complete its designed mission or function. When you define "mission," take into account storage, alert, captive-carry, launch, and flight of the item.

A5.2.1.1. Calculate the value of WSR by dividing the number of successfully completed missions by the number of attempted missions. Success of the mission should relate performance to design capability. For most munitions, there may only be one mission, and thus a need for only one WSR value. Peacetime missions for pods and missiles may significantly differ from wartime missions. In such cases, develop a WSR value for each mission. If platform environments differ dramatically, either provide a WSR value for the harshest environment or develop WSR values for each environment or pylon.

A5.2.2. Mean Time Between Maintenance (MTBM). Use MTBM to calculate the average life units between maintenance events, as defined by the operational command.

A5.2.2.1. Apply MTBM to those items that operate or are active during times other than actual free flight. If reported, use captive-carry and ground operating hours as the time base for applicable items; otherwise, use PHs. PHs include time in which the system is not operating or is in a storage or dormant condition.

A5.2.2.2. Current and planned maintenance information systems permit tracking of several standard MTBM parameters, including:

- MTBM (inherent malfunctions).
- MTBM (induced malfunctions).
- MTBM (no-defect events).
- MTBM (total corrective events).
- MTBM (preventive maintenance).
- MTBR (mean time between removal).

A5.2.2.3. Specify a single peacetime and wartime value for MTBM and MTBR. Use an appropriate MTBM or MTBR measure based on specific MAJCOM needs.

A5.3. Maintainability. MAJCOMs must consider maintainability measures when describing top-level logistics requirements for air-launched missiles, munitions, and pods systems.

A5.3.1. Mean Downtime (MDT). Use MDT to measure the average elapsed time between losing MC status and restoring the system to MC status.

A5.3.1.1. MDT quantifies the clock time required to return a system to at least PMC status. Downtime includes:

- Maintenance and supply response.
- Administrative delays.
- Actual on-equipment repair.
- Activities that result in NMC status, such as:
- Training.
- Preventive maintenance.

A5.3.1.2. When calculating MDT, also consider:

- TO availability and adequacy.
- Support equipment capability and availability.
- Supply levels.
- Manning.
- Experience levels.
- Shift structure.

NOTE:

MDT describes an operational environment, it is not the same as the contractual term, MTTR.

A5.3.2. Mean Repair Time (MRT). Use MRT to measure the average on-equipment or off-equipment corrective maintenance time in an operational environment. State MRT requirements for on-equipment at the system level and off-equipment at the LRU level.

A5.3.2.1. MRT starts when the technician arrives at the system or equipment for on-equipment maintenance or receives the LRU at the off-equipment repair location. The time includes all maintenance taken to correct the malfunction, including:

- Preparing tests.
- Troubleshooting.
- Removing and replacing parts.
- Repairing.
- Adjusting.
- Conducting functional checks.

EXCEPTION: Don't include maintenance or supply delays when calculating MRT.

NOTE:
Don't confuse the operational term MRT, with the contractual term MTTR.

A5.3.2.2. Express MRT as:

$$\text{MRT (on - equipment)} = \frac{\text{Total on - equipment corrective maintenance time}}{\text{Total number of on - equipment maintenance events}}$$

A5.4. Integrated Diagnostics. See attachment **Error! Bookmark not defined.**

A5.5. Software. See attachment **Error! Bookmark not defined.**

A5.6. Manpower. MAJCOMs must consider manpower measures when describing top-level logistics requirements for air-launched missiles, munitions, and pods systems.

A5.6.1. Maintenance Man-Hours per Life Unit (MMH/LU). Use MMH/LU to calculate the average man-hours per life unit needed to maintain a system. Use the MTBM life units as the time base for maintenance man-hours.

A5.6.1.1. Operational commands define MMH/LU according to their specific needs. Current and planned maintenance data collection and processing systems use PHs as the time base and permit tracking of several standard MMH/PH terms, including:

- MMH/PH support general (WUC 01-09).
- MMH/PH corrective (WUC 11-99) for inherent malfunctions, induced malfunctions, no-defect action, or total events.
- MMH/PH product improvement (TCTO).
- MMH/PH preventive maintenance (time change items).
- MMH/PH total of above categories.

A5.6.1.2. Establish a single required peacetime and wartime MMH/LU value. Use an appropriate MMH/LU measure based on specific MAJCOM needs. The above example uses PHs as the life unit, but this is not required.

A5.7. Deployability. MAJCOMs must consider deployability measures when describing top-level requirements for air-launched missiles, munitions, and pods systems. Address:

- Whether the system can be deployed to the theater of operations within the constraints of the user defined requirements.
- Maintenance planning factors:
- Manpower
- Interoperability.
- Compatibility.
- Environmental concerns.
- Safety.
- Maintenance facilities.
- Depot support.

A5.7.1. Deployment Footprint. A system's deployment footprint defines the manpower, materiel, and equipment required to initially support the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. As a basis of measure, use, for example, equivalent pallet positions. See DoD Instruction 5000.2, part 6, section C, for an outline of the requirements for a design reference mission profile.

A5.7.2. Logistics Support Tail. A system's logistics support tail defines the manpower, materiel, and equipment required to sustain the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. Logistics support requirements must account for all manpower, materiel, and equipment directly or indirectly associated with the weapon system under consideration. For example, low reliable, mission critical systems require high levels of support (manpower and supplies) to sustain the mission over a given period of time.

Attachment 6

GROUND COMMUNICATIONS-ELECTRONICS, TRAINERS, AND SUPPORT EQUIPMENT SUPPORTABILITY MEASURES

A6.1. This category includes all equipment associated with requirements for operating and maintaining a weapon system, including:

- Ground communications-electronics equipment.
- Trainers and training equipment.
- All mobile or fixed equipment.
- Ground segment equipment for ground-launched missile systems.

A6.2. Availability and Sustainability. MAJCOMs must consider availability and sustainability measures when describing top-level logistics requirements for ground communications-electronics, trainers, and support equipment systems. Use the equations in this attachment to develop these measures.

A6.2.1. Mission-Capable (MC) Rate. Use MC rates to calculate the percentage of possessed time that a weapon system can perform any of its assigned missions. Calculate the value of MC by using the sum of FMC and PMC rates. Express MC as:

MC = FMC + PMC

A6.2.2. Uptime Ratio (UTR). Use UTR to calculate the percentage of time that operational equipment can satisfy critical mission needs relative to the designated operational capability (DOC). Express all times in clock hours.

A6.2.2.1. UTR is similar to MC rate except that system status depends on current use of the system as well as the DOC. For example, a system with several DOC missions can be MC if at least one of those missions can be accomplished. However, if an immediate need exists for a mission capability that is "down" (other mission capabilities are "up"), the overall system is considered to be "down."

A6.2.2.2. Operational commands define baseline operating hours. For example, express baseline hours as:

$$\text{UTR} = \frac{\text{Total operating hours - total downtime hours}}{\text{Totaloperating hours}}$$

A6.2.3. Utilization Rate (UR). Use UR to calculate the average life units used or missions attempted per system during a specified interval of calendar time. Express this term as a ratio of planned or actual operating hours to PHs for a given calendar period. For example:

$$\text{UR} = \frac{\text{Operating hours}}{\text{PH}}$$

A6.2.3.1. Establish required peacetime and wartime UR values.

A6.3. Reliability. MAJCOMs must consider reliability measures when describing top-level logistics requirements for ground communications-electronics, trainers, and support equipment systems.

A6.3.1. Mean Time Between Critical Failure (MTBCF). Use MTBCF to measure the average time between failures of mission-essential system functions. For ground electronic systems, MTBCF equals the total equipment operating time in hours, divided by the number of mission essential system failures. MTBCF includes all critical hardware and software failures that occur during mission and non-mission time. Express MTBCF as:

$$\text{MTBCF} = \frac{\text{Number of operating hours}}{\text{Number of critical failures}}$$

A6.3.2. Mean Time Between Maintenance (MTBM). Use MTBM to calculate the average life units between maintenance events. Use operating hours, if reported, as the time base for applicable items; otherwise, use PHs.

A6.3.2.1. Apply MTBM to items in active operation for long periods of time.

A6.3.2.2. Current and planned maintenance information systems permit tracking of several standard MTBM measures, including:

- MTBM (inherent malfunctions).
- MTBM (induced malfunctions).
- MTBM (no-defect events).
- MTBM (total corrective events).
- MTBM (preventive maintenance).
- MTBR (mean time between removal).

Use an appropriate MTBM or MTBR measure based on specific MAJCOM needs.

A6.4. Maintainability. MAJCOMs must consider maintainability measures when describing top-level logistics requirements for ground communications-electronics, trainers, and support equipment systems.

A6.4.1. Mean Downtime (MDT). Use MDT to measure the average elapsed time between losing MC status and restoring the system to MC status.

A6.4.1.1. The downtime clock continues to run until maintenance personnel return the system to at least PMC status. Downtime includes:

- Maintenance and supply response.
- Administrative delays.
- Actual on-equipment repair.
- Activities that result in NMC status such as:
- Training.
- Preventive Maintenance.

A6.4.1.2. When computing MDT, also consider:

- TO availability and adequacy.

- Support equipment capability and availability.
- Supply levels.
- Manning.
- Experience levels.
- Shift structure.

A6.4.2. Mean Repair Time (MRT). Use MRT to measure the average on-equipment or off-equipment corrective maintenance time in an operational environment. State MRT requirements for on-equipment at the system level and off-equipment at the assembly, subassembly, module, or circuit card assembly level.

A6.4.2.1. MRT starts when the technician arrives at the system or equipment for on-equipment maintenance or receives the assembly, subassembly, module, or circuit card assembly at the off-equipment repair location. The time includes all maintenance done to correct the malfunction, including:

- Test preparation.
- Troubleshooting.
- Removing and replacing parts.
- Repairing.
- Adjusting.
- Conducting functional checks.

EXCEPTION: MRT doesn't include maintenance or supply delays.

NOTE:

Don't confuse the operational term MRT with the contractual term MTTR.

A6.5. Integrated Diagnostics. See attachment **Error! Bookmark not defined.**.

A6.6. Software. See attachment **Error! Bookmark not defined.**.

A6.7. Manpower. MAJCOMs must consider manpower measures when describing top-level logistics requirements for ground communications-electronics, trainers, and support equipment systems.

A6.7.1. Maintenance Man-Hours per Life Unit (MMH/LU). Use MMH/LU to measure the average man-hours per life unit needed to maintain a system.

A6.7.1.1. Use PHs as the time base for ground electronic systems.

A6.7.1.2. Current and planned maintenance information systems permit tracking of several standard MMH/PH terms, including:

- MMH/PH support general (WUC 01-09).
- MMH/PH corrective (WUC 11-99) for inherent malfunctions, induced malfunctions, no-defect actions, or total.
- MMH/PH product improvement TCTO.

- MMH/PH total of above categories.

A6.7.1.3. Use an appropriate MMH/LU term based on specific MAJCOM needs and establish its value as a readiness requirement. The above example uses PHs as the life unit, but this isn't required.

A6.7.2. Maintenance Personnel per Operational Unit (MP/U). Develop manpower projections to support operating and maintenance concepts. *EXCEPTION:* When calculating MP/U, don't include depot level and other personnel that are excluded from maintenance planning factors by AFI 38-201.

A6.8. Deployability. MAJCOMs must take into account deployability considerations in describing top-level requirements for communications-electronics, trainers, and support equipment systems. Address:

- Whether the system can be deployed to the theater of operations within the constraints of the user defined requirements.
- Maintenance planning factors:
- Manpower
- Interoperability.
- Compatibility.
- Environmental concerns.
- Safety.
- Maintenance facilities.
- Depot support.

A6.8.1. Deployment Footprint. A system's deployment footprint defines the manpower, materiel, and equipment required to initially support the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. As a basis of measure, use, for example, equivalent pallet positions. See DoD Instruction 5000.2, part 6, section C, for an outline of the requirements for a design reference mission profile.

A6.8.2. Logistics Support Tail. A system's logistics support tail defines the manpower, materiel, and equipment required to sustain the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. Logistics support requirements must account for all manpower, materiel, and equipment directly or indirectly associated with the weapon system under consideration. For example, low reliable, mission critical systems require high levels of support (manpower and supplies) to sustain the mission over a given period of time.

Attachment 7

SUBSYSTEMS, LINE REPLACEABLE UNITS, AND MODULES SUPPORTABILITY MEASURES

A7.1. Availability and Sustainability. MAJCOMs must consider availability and sustainability measures when describing top-level logistics requirements for subsystems, line replaceable units, and modules. Use the equations in this attachment to develop these measures.

A7.1.1. Operational Availability (A_o). Use Ao to measure the percentage of time that a subsystem, line replaceable unit (LRU), or line replaceable module (LRM) can satisfactorily perform in an operational environment.

A7.1.1.1. Ao for subsystems, LRUs, and LRMs is similar to the MC rate for aircraft, communications, electronics, and some missile systems. Express Ao as:

$$A_o = \frac{MTBDE}{MTBDE + MDT}$$

where:

- MTBDE is the average time between events that bring the system down including critical or non-critical failures, preventive maintenance, and training.
- MDT is the total elapsed time to restore the subsystem, LRU, or LRM to full operable status, as a result of a downing event.

NOTE:

Ao doesn't express whether an item can operate over a specific period of time. This characteristic is covered in WSR.

A7.1.2. Other Parameters. For subsystems, LRUs, and LRMs, apply the definitions and discussion of the appropriate reliability and maintainability measures as described for the parent system in attachments 3, 4, 5, and 6 of this instruction.

A7.2. Deployability. MAJCOMs must take into account deployability considerations in describing top-level requirements for aircraft subsystems, line replaceable units, and modules. Address:

- Whether the system can be deployed to the theater of operations within the constraints of the user defined requirements.
- Maintenance planning factors:
- Manpower.
- Interoperability.
- Compatibility.
- Environmental concerns.
- Safety.
- Maintenance facilities.

- Depot support.

A7.2.1. Deployment Footprint. A system's deployment footprint defines the manpower, materiel, and equipment required to initially support the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. As a basis of measure, use, for example, equivalent pallet positions. See DoD Instruction 5000.2, part 6, section C, for an outline of the requirements for a design reference mission profile.

A7.2.2. Logistics Support Tail. A system's logistics support tail defines the manpower, materiel, and equipment required to sustain the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. Logistics support requirements must account for all manpower, materiel, and equipment directly or indirectly associated with the weapon system under consideration. For example, low reliable, mission critical systems require high levels of support (manpower and supplies) to sustain the mission over a given period of time.

Attachment 8

INTEGRATED DIAGNOSTICS (ID) SUPPORTABILITY MEASURES

A8.1. Integrated Diagnostics Defined. ID combines a system's automated, semiautomated, and manual diagnostic resources to create a total system support structure that gives appropriate personnel required performance information when needed and sets up support mechanisms to efficiently isolate all faults.

A8.1.1. ID's design process maximizes diagnostic effectiveness by integrating seven elements:

- On-board mission environmental monitoring.
- Built-in tests (BIT).
- Support equipment including automatic test equipment (ATE).
- Portable maintenance aids (PMA).
- Reusable test data.
- CALS-compatible, electronic TOs.
- On-the-job-training (OJT) for maintenance personnel.

A8.1.1.1. Using automatic and manual procedures, ID strives to unambiguously detect and isolate 100 percent of the known or expected faults that occur or might occur in all prime mission system equipment and associated support, test, and training equipment.

A8.2. General Discussion. ID addresses the system's capability to quickly and effectively identify any significant change in a mission-essential function and signal the change to the operator. Equally important, the ID approach must provide diagnostic support elements, such as technical data, test equipment, and training, that maintenance technicians need to efficiently and effectively isolate the specific malfunctioning item. The ID approach must align with the maintenance concept at each level.

A8.2.1. For unit-level maintenance, ID must isolate any malfunctioning LRU, LRM, line replaceable item, or interconnecting wiring, connectors, or buses. ID must also identify and isolate any software anomaly that negatively affects the system's ability to support the mission.

A8.2.2. The ID concept must include features designed to minimize anomalies that result in false alarms (FA), cannot duplicate (CND) situations, and retest OKretest ok (RTOK) events. Available technology, system design, manpower, skill constraints, and operational performance requirements drive the appropriate mix of automated, semiautomated, and manual diagnostics.

A8.2.3. MAJCOMs and SMs conduct cost and design tradeoff studies to identify the most cost and operationally effective ID capability.

A8.3. Measuring ID Performance. MAJCOMs must consider using the percentage of critical faults identified (CFI) and unconfirmed faults per life unit (UF/LU) as the two primary measures of ID performance.

A8.3.1. Percentage of Critical Faults Identified (CFI). This parameter addresses the philosophy that an ID must identify degradations and signal them to an operator in an understandable manner and within operator identified response times without relying solely on BIT. Express CFI as:

$$\text{\% of CFI} = \frac{\text{Number of mission critical degradations identified by the operator/aircrew within operator specified response times}}{\text{Total number of mission critical failure occurring during the mission and identified either during or after the mission}} \times 100$$

A8.3.2. Unconfirmed Faults per Life Unit (UF/LU). UF/LU measures the frequency of unconfirmed faults as a function of the system's life cycle. Express UF/LU as:

$$\text{UF / LF} = \frac{\text{Number of unconfirmed faults}}{\text{Life unit}}$$

A8.3.2.1. Unconfirmed faults include FAs and CNDs. Refer to the formula as FA/LU if using only FAs. Likewise, refer to the formula as CND/LU if using only CNDs.

A8.4. Other Indicators. MAJCOMs must consider using performance indicators for automated diagnostics that support operations and maintenance. Calculate performance indicators in percentages of:

- BIT fault detection (FD).
- BIT fault isolation (FI).
- Faults that terminate in a CND.
- Retest OK (RTOK).

NOTE:

These parameters contribute to the overall ID requirement. Don't consider them in isolation.

A8.4.1. Percent of BIT Fault Detection (FD). Use BITFD to measure maintenance requests initiated when equipment performance (including BIT performance) is less than what is required to perform a satisfactory mission, and corrective action is necessary to restore equipment performance. This formula assumes the user requires 100-percent diagnostic capability:

$$\text{\% of BITFD} = \frac{\text{Number of failures detected by BIT that result in an O - level troubleshooting action}}{\text{Number of O - level troubleshooting actions detected via all methods}} \times 100$$

A8.4.2. Percent of BIT Fault Isolation (FI). Use BITFI to measure how well BIT isolates faults. BIT should fault isolate aircrew-reported and manually detected faults, as well as BIT-detected faults. Isolation means the fault is unambiguously isolated to a single-item node (driver, receiver, connector, wire) or to a specified maximum number of items (an ambiguity group of "n" items). The formula is:

$$\text{\% of BITFI} = \frac{\text{Number of fault isolations in which BIT effectively contributed}}{\text{Number of confirmed faults detected via all methods}} \times 100$$

A8.4.3. Percent of Faults that Terminate in a Cannot Duplicate (CND). Use percent of faults that terminate in a CND to measure the volume burden to O-level maintenance through FIs that end in a CND. The formula is:

$$\text{\% of CND} = \frac{\text{Number of O - level FIs that terminate in a CND}}{\text{Number of O - level troubleshooting actions}} \times 100$$

(excludes FAs that do not generate maintenance actions)

A8.4.4. Retest OK (RTOK) Rate. Use RTOK rate to measure the volume burden to a given maintenance level through FIs that end in RTOK. This affects both manpower and the supply pipeline and is expressed as follows:

$$\text{RTOK Rate} = \frac{\text{Number of units (LRUs, SRUs) that RTOK at a higher maintenance level}}{\text{Number of units tested at a higher maintenance level}} \times 100$$

Attachment 9

SOFTWARE DESIGN AND SUPPORTABILITY MEASURES

A9.1. MAJCOMs must consider software design and supportability measures when describing top-level logistics requirements for weapon system and support system software.

A9.1.1. Software Maturity. Use software maturity to measure the progress of software development toward satisfying operational requirements. This progress is based on the number and severity of problems that require software changes.

A9.1.1.1. Software maturity measures the rate at which software problems are discovered and resolved. Software problems are those which require software changes to correct errors in system design and improve or modify a system's function.

A9.1.1.2. Use table A9.1 to assign a severity level and associated weighting factor to each software problem. As you make software changes to correct the problems, sum the weighted problems that are originated and closed. Keep statistics and plot the results over time to provide indicators of overall software maturity. Indicators include:

- Trend of the accumulated weighted software unique failures versus time.
- Trend of the difference between the weighted software failures discovered versus the weighted software failures resolved.
- Trend of the average severity of the software failures versus time.
- Trend of the time necessary to implement software changes.

Table A9.1. Software Severity Levels and Weights.

Priority/ Severity Level	Impact	Description	Severity Weight (Points)
1	System Abort	A software or firmware problem that results in a system abort.	30
2	System Degraded No Work Around	A software or firmware problem that severely degrades the system and no alternative work around exists.	15
3	System Degraded Work Around	A software or firmware problem that severely degrades the system and an alternative work around exists (e.g., system rerouting through operator actions).	5
4	Software Problem	An indicated software or firmware problem that doesn't severely degrade the system or any essential system function.	2
5	Minor Fault	All other minor deficiencies or nonfunctional faults.	1

A9.1.1.3. Although the total number of weighted software problems discovered and resolved may be very large, the resulting difference between problems discussed and resolved must be kept to a minimum. This is especially true for mission critical, safety critical, and high-reliability systems.

A9.1.1.4. None of the indicators in themselves are direct measures of software maturity. Consider all indicators together.

A9.1.1.5. Begin measuring software maturity after completing the software test plan. Continuous measurement helps to prevent software from entering the field with known problems that could abort or degrade the mission. See DoD-STD 2167-A, Appendix C for a more detailed description.

A9.1.1.6. Assign severity points to program restarts or reboots--whether or not they are successful--based on the impact an unsuccessful restart or reboot had, or would have had, on the mission.

A9.1.2. Growth Capacity. Use growth capacity to calculate a computer system's capacity to handle added functions and system users.

A9.1.2.1. Growth capacity ensures that sufficient processing power and memory exists to make room for required changes after a system is delivered to the field. For example, growth capacity may be stated as a requirement for the delivered computer system to have:

- A minimum of "X" percent of reserve computer memory in contiguous memory locations.
- A minimum of "Y" percent reserve timing for each computational cycle.
- An overall average of "Z" percent for all cycles.
- The capability to expand by "A" percent.

A9.1.3. Block Release Cycle. Use block release cycle to calculate the anticipated frequency and number of software changes needed periodically.

A9.1.3.1. After a system is fielded, appropriate personnel normally develop and release new versions of software based on a block release cycle. Define this cycle using:

- The interval of time during which personnel make software block changes.
- The number of changes in the block.

For example, express block release cycle requirements as "block releases every 'X' months with an average of 'Y' changes per release."

A9.1.4. Reliability. Use reliability to calculate the probability that software will remain failure-free for a specified time under specified conditions. In a system context, software reliability is the probability that software will not cause failure of the system for a specified time under specified conditions.

A9.1.4.1. Sources of failure include system inputs and uses, as well as existing software faults. Count software defects that cause the system to fail in the system-reliability allocation. In cases where this is not practical, specify software reliability separately. State the reliability requirement as:

$$\text{MTBCF} = \frac{\text{Cumulative central processing unit time}}{\text{Cumulative failures}}$$

A9.1.5. Module Size. Calculate module size using an aggregate of executable, nonexpandable software statements.

A9.1.5.1. In higher order languages, software modules are generally defined as functions or procedures with a specific beginning and end. Large modules tend to have more errors and are generally more difficult to maintain. Take into account code complexity and efficiency when determining software module size. State maximum size as:

A module will not exceed "n" statements.

A9.1.6. Machine Independence. Use machine independence to calculate software dependence on the machine's architecture.

A9.1.6.1. Machine-dependent software is tied to the inherent architecture of the computer processor. Machine-dependent software is generally more expensive to support over the software's life cycle than software that can run on several machines. A change in the processor forces a change in the machine-dependent code. Assess costs and risks associated with modifying machine dependent code.

A9.1.6.2. The percentage of machine-dependent code varies with different systems under development. Communication systems (such as network control systems), operating systems, and system executives may contain significant amounts of machine-dependent code because their functions are closely tied to the hardware. State requirements for machine-dependent software as:

Amount of machine independent code = "X" percent of total code

A9.1.6.3. Calculate machine independence for each module. If a module contains machine-dependent code, then the entire module qualifies as machine dependent. This encourages developers to use machine-dependent code in only a few small modules and helps to ensure that developers create software that personnel can easily and inexpensively modify. ***EXCEPTION:*** Don't assess machine dependence for assembly languages or special-purpose processors that use their own languages. Both of these cases require 100-percent machine-dependent software.

A9.1.7. Software Maintainability. Software maintainability is the ease in which changes to software source code and its associated documentation can be made. Measure software maintainability through an evaluation of module size, complexity, descriptiveness, portability, traceability, and consistency. Use automated software evaluation tools to measure software maintainability.

Attachment 10

SPACE, SPACE SURVEILLANCE, AND MISSILE WARNING SYSTEMS SUPPORTABILITY MEASURES

A10.1. Space, space surveillance, and missile warning systems normally operate in networked environments and usually contain four segments: launch, space, control, and user. When such systems contain more than one segment, derive the overall system readiness from a contribution from each separate segment. Apply RM&D concepts more extensively to the segmented systems.

A10.2. Overall System. MAJCOMs must consider top-level logistics requirements for space, space surveillance, and missile warning systems. Use the equations in this attachment to develop these requirements.

A10.2.1. Mission Effectiveness (ME). ME measures system capability. Use ME to calculate the probability that an available system will initiate its mission and will be dependable once the mission is initiated. Express availability and dependability in consistent terms, with ME defined as:

$$ME = \mathbf{A_o \times D_o}$$

A10.2.2. Operational Availability ($\mathbf{A_o}$). Use Ao to measure the probability that a system is operable and can be committed to start a mission at any given time.

A10.2.2.1. Ao includes the inherent RM&D parameters and a system's logistics support effectiveness as it relates to nonmission time. Define Ao as:

$$\mathbf{A_o} = \frac{MTBDE}{MTBDE + MTTRS}$$

A10.2.2.2. Mean time between downing events (MTBDE) describes the average period of time between nonmission downing events. Compute it by dividing the total nonmission time by the number of events the system sustains before it fails to initiate its mission. A downing event qualifies as any event occurring during nonmission time that affects the system's ability to initiate a mission. Downing events include those caused by hardware and software faults or preventive maintenance.

A10.2.2.3. Mean time to restore system (MTTRS) describes the average period of time needed to restore a down system during nonmission time. Express MTTRS as the total time needed to restore a system to an operable condition divided by the number of downing events it sustained. MTTRS may include both scheduled and unscheduled maintenance events.

A10.2.3. Operational Dependability (Do). Use Do to calculate the probability that the system will operate and perform its required functions at any given time during a mission profile. It only applies to systems available at the start of a mission.

A10.2.3.1. Do includes the system's inherent RM&D parameters and its logistics support effectiveness as it is calculated during mission time. Define Do as:

$$D_o = \frac{MTBCF}{MTBCF + MTTRF}$$

A10.2.3.2. Mean time between critical failure (MTBCF) describes the average period of time between critical failures during an active mission time. Compute it by dividing the total amount of mission time by the total number of critical failures during a specified series of missions. MTBCF includes actual failures of system components or software and any scheduled preventive maintenance that must be accomplished during mission time.

A10.2.3.3. Mean time to restore function (MTTRF) describes the average period of time needed to resolve critical failures that occur during mission time. Express it as the total time needed to restore interrupted mission functions divided by the number of critical failures that occur over the course of a specified mission profile. MTTRF includes both scheduled and unscheduled maintenance.

A10.2.4. Mission Reliability (MR). Use MR to measure the degree to which the system is operable and can perform its required function for the mission's duration or a specified period of time.

A10.2.4.1. Base MR on system reliability during mission time only. MR doesn't take into account system maintainability. Many missions and systems don't allow personnel to restore specific functions during the mission. Define MR as:

$$MR = e^{-t/MTBCF}$$

where *t* is the mission duration.

A10.2.5. Logistics Reliability and Maintainability. Use logistics reliability and maintainability factors to measure the demand for logistics resources that operate regardless of mission capability status. Use:

- Mean time between maintenanceMean Time Between Maintenance (MTBM) and mean maintenance timeMean Maintenance Time (MMT) to measure demand for maintenance resources.
- Mean time between demands (MTBD) to measure the demand for supply resources.

A10.2.5.1. MTBM describes the average time between maintenance events, both scheduled and unscheduled. Express MTBM as:

$$MTBM = \frac{MTBUM \times MTBSM}{MTBUM + MTTSM}$$

where,

- MTBUM is mean time between unscheduled maintenance.
- MTBSM is mean time between scheduled maintenance.

A10.2.5.2. MMT describes the average time needed to complete a maintenance action. Express MMT as:

$$\text{MMT} = \frac{\text{total maintenance time}}{\text{number of scheduled and unscheduled maintenance events}}$$

A10.2.5.3. MTBD describes the average time between demands on the supply system. Express MTBD as:

$$\text{MTBD} = \frac{\text{total system operating time}}{\text{number of items reqested from supply}}$$

A10.3. Launch Segment. MAJCOMs must consider launch segment measures when describing top-level logistics requirements for space, space surveillance, and missile warning systems.

A10.3.1. Launch Availability (LA). Use LA to calculate the ability of the launch vehicle and its infrastructure to initiate a launch profile during nonmission time. Define this calculation as:

$$\text{LA} = \frac{\text{LMTBDE}}{\text{LMTBDE} + \text{LMTTRS}}$$

A10.3.1.1. Launch mean time between downing events (LMTBDE) describes the average period of time between downing events that occur during the nonmission portion of the launch profile. Downing events that occur during launch preparation, that is, during build-up, checkout, and launch-pad preparation, could result in a launch abort.

A10.3.1.2. Launch mean time to restore system (LMTTRS) describes the average period of time needed to restore the system after downing events occur during launch profile nonmission time.

NOTE:

Nonmission time ends when the countdown starts.

A10.3.2. Launch Dependability (LD). Use LD to calculate the probability that a launch-vehicle configuration is operable and can perform its required functions at any given time during a mission profile. It only applies to launch vehicles available to start the mission profile. Calculate operational dependability of launch vehicles based on mission time RM&D parameters. Define LD as :

$$\text{LD} = \frac{\text{LMTBCF}}{\text{LMTBCF} + \text{LMTTRF}}$$

A10.3.2.1. Launch mean time between critical failure (LMTBCF) describes the average time between critical failures that occur during the launch profile's active mission time. Categorize events that occur during active launch profiles as critical failures if they could result in launch aborts. Use LMTBCF to measure the launch-vehicle configuration's reliability.

A10.3.2.2. Launch mean time to restore function (LMTTRF) describes the average period of time needed to resolve critical failures that occur during a launch profile's mission time. ***NOTE:*** Mission time starts at launch countdown.

A10.3.3. Launch Reliability (LR). Use LR to calculate the probability that the launch-vehicle configuration is operable and will perform its required function during a specified mission duration. Base LR on the reliability parameter associated with launch segment mission time. Defined LR as:

$$MR = e^{-t/LMTBCF}$$

where *t* is the mission duration.

A10.3.4. Launch Effectiveness (LE). Use LE to assess the launch vehicle's overall ability to successfully complete a launch. LE takes into account factors associated with nonmission and mission time, as well as the period after lift-off. Define LE as:

where LA, LD, and LR are expressed in consistent terms.

A10.3.5. Maintenance Man-Years per Launch (MMY/L). Use MMY/L to measure total manpower-maintenance resource requirements associated with the launch-vehicle configuration. MMY/L includes nonmission time (for example, launch pad preparation and build-up) and active-mission time (for example, prelaunch, launch, and postlaunch operations).

A10.3.6. Pad Turnaround Time. Use pad turnaround time to measure the total time associated with preparing and configuring the pad after it launches a similarly configured launch vehicle.

A10.4. Space Segment. MAJCOMs must consider space segment measures when describing top-level requirements for space, space surveillance, and missile-warning systems.

A10.4.1. Space Availability (SA). Use SA to calculate the probability that a space segment is operable and can be committed to start a mission at any given time. Define SA as:

$$SA = \frac{SMTBDE}{SMTBDE + SMTTRS}$$

A10.4.1.1. Space mean time between downing event (SMTBDE) describes the average time between nonmission-time downing events. Divide the total space segment nonmission time by the number of downing events. A downing event is any event that places the space segment in a condition in which it is unable to initiate a mission.

A10.4.1.2. Space mean time to restore system (SMTTRS) describes the average period of time needed to restore the space segment from nonmission-time downing events. Calculate it as the total time needed to restore the space segment from downing events divided by the number of downing events. SMTTRS includes restoral time from both scheduled and unscheduled maintenance events.

A10.4.2. Space Dependability (SD). Use SD to measure the probability that a space segment is operable and can perform its required functions at any given time during space mission time. SD applies only to space segments available at the start of the mission.

A10.4.2.1. Space segment state includes the combined effects of mission-related R&M parameters, but excludes non-mission time R&M factors. Define SD as:

$$SD = \frac{SMTBCF}{SMTBCF + SMTTRF}$$

A10.4.2.2. Space mission time between critical failure (SMTBCF) describes the average time between critical failures that occur during active missions. Calculate it as the total amount of space segment mission time divided by the number of space segment critical failures.

A10.4.2.3. Space mean time to restore function (SMTTRF) describes the average period of time needed to resolve critical failures that occur during a space segment's mission time. Calculate it as the total time required to restore critically failed mission functions divided by the number of critical failures.

A10.4.3. Space Reliability (SR). Use SR to calculate the probability that a space segment is operable and will perform its required function during a specified mission duration. Base SR on the effects of mission time reliability. Define it as:

$$MR = e^{-t/LMTBCF}$$

where *t* is the mission duration.

A10.4.4. Space Effectiveness (SE). Use SE to calculate the probability that a space segment is operable, will initiate a mission, and will continue to perform its initiated mission. Calculate SE as:

$$SE = SA \times SD$$

where SA and SD are expressed in consistent terms.

A10.5. Control Segment. MAJCOMs must consider control segment measures when describing top-level requirements for space, space surveillance, and missile warning systems.

A10.5.1. Control Availability. Use CA to calculate the probability that a control segment is operable and can be committed to start a mission at any given time. A control segment's state includes the combined effects of nonmission-related R&M parameters. Don't factor in mission time. Define CA as:

$$CA = \frac{CMTBDE}{CMTBDE + CMTTRS}$$

A10.5.1.1. Control mean time between downing events (CMTBDE) describes the average time between nonmission-time downing events. Calculate it by dividing the total control segment nonmission time by the number of downing events. A downing event is any event that places the control segment in a condition in which it is unable to initiate a mission.

A10.5.1.2. Control mean time to restore system (CMTTRS) describes the average time needed to restore the control segment from nonmission-time downing events. Calculate it by dividing the total time needed to restore a control segment by the number of downing events. CMTTRS includes restoral time from both scheduled and unscheduled maintenance events.

A10.5.2. Control Dependability (CD). Use CD to calculate the probability that a control segment is operable and will perform its required functions at any given time during a mission. It only applies to control segments available at the mission's start. A control segment's state includes the combined effects of mission-related RM&D parameters. Don't factor in nonmission-time RM&D factors. Define CD as:

$$CD = \frac{CMTBCF}{CMTBCF + CMTTRF}$$

A10.5.2.1. Control mean time between critical failure (CMTBCF) describes the average time between critical failures that occur during active mission time. Calculate it by dividing the total amount of control segment mission time by the number of control segment critical failures.

A10.5.2.2. Control mean time to restore function (CMTTRF) describes the average period of time to resolve critical failures that occur during mission time of the control segment. Calculate it by dividing the total time needed to restore mission functions from critical failures by the number of critical failures. CMTTRF includes recovery time from both scheduled and unscheduled maintenance events.

A10.5.3. Control Reliability (CR). Use CR to calculate the probability that a control segment is operable and will perform its required function over the duration of a specified mission. CR is based on the effects of mission-time reliability only. Define CR as:

$$MR = e^{-t/CMTBCF}$$

where *t* is the mission duration.

A10.5.4. Control Effectiveness (CE). Use CE to calculate the probability that a control segment is operable, will initiate a mission, and will perform its mission once initiated. Calculate CE as:

$CE = CA \times CD$

where CA and CD are expressed in consistent terms.

A10.6. User Segment. MAJCOMs must consider user-segment measures when describing top-level requirements for space, space surveillance, and missile warning systems.

A10.6.1. User Availability (UA). Use UA to calculate the probability that a user segment is operable and can be committed to start a mission at any given time. Begin measuring user segment at the start of a mission and include the combined effects of readiness-related parameters. Express UA as:

$$UA = \frac{UMTBDE}{UMTBDE + UMTTRS}$$

A10.6.1.1. User mean time between downing events (UMTBDE) describes the average period of time between nonmission time downing events. Calculate it by dividing the total user segment nonmission time by the number of downing events. A downing event is any event that places the user segment in a condition in which it is unable to initiate a mission.

A10.6.1.2. User mean time to restore system (UMTTRS) describes the average period of time needed to restore the user segment from downing events that occur during nonmission time. Calculate it by dividing the total time required to restore the user segment by the number of downing events. UMTTRS includes restoral time from both scheduled and unscheduled maintenance events.

A10.6.2. User Dependability (UD). Use UD to calculate the probability that a user segment is operable and can perform its required functions during any given mission time. It only applies to user segments available at the start of the mission. User segment state includes the combined effects of mission-related RM&D parameters, but excludes non-mission time RM&D factors. Express UD as:

$$UD = \frac{UMTBCF}{UMTBCF + UMTTRF}$$

A10.6.2.1. User mean time between critical failure (UMTBCF) describes the average time between active-mission time critical failures. Calculate it by dividing the total amount of user segment mission time by the number of user-segment critical failures.

A10.6.2.2. User mean time to restore function (UMTTRF) describes the average period of time needed to resolve mission-time critical failures of the user segment. Calculate it by dividing the total time needed to restore mission functions from critical failures by the number of critical failures.

A10.6.3. User Reliability (UR). Use UR to calculate the probability that a user segment is operable and will perform its required function during a specified mission duration. Base UR on the effects of mission time reliability. Expressed it as:

$$MR = e^{-t/UMTBCF}$$

where *t* is the mission duration.

A10.6.4. User Effectiveness (UE). Use UE to calculate probability that a user segment is operable, will initiate a mission, and perform its mission once initiated. Calculate UE as:

$$UE = UA \times UD$$

where UA and UD are expressed in consistent terms